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WHAT'S AHEAD for INDUSTRY and PROFESSION?

TO FORECAST the direction and extent of developments in chemical engineering and in the process industries is a difficult and hazardous undertaking. About all one can do is to study the records of the past in the hope of discovering a few trends which, with due reservations, may be cautiously projected into the future. That is just what is attempted in this issue of *Chem. & Met.* The articles that follow reflect some of the important trends of technology while in these editorial pages an attempt is made to relate those trends more specifically to the problems faced by the industry and profession as it moves into 1938.

Business considerations come first. Our progress as individuals or as groups depends upon our success in producing and selling goods or services. Fortunately, the diversified character of our industries and the fact that most of them are still in an early stage of their growth and development helped greatly in resisting the depression of 1932 and 1933. Likewise these influences stimulated prompt and complete recovery so that operations for the first nine months of 1937 approached or actually exceeded the 1929 level. In the last quarter, however, the heavy chemical industries dropped perhaps 20 per cent below the peak of last year although for 1937 as a whole the average was probably 15 per cent better than in 1936. Organic chemicals, plastics and resins, and many other newer branches of the industry have been less drastically affected and there is already a definite trend upward. This is not only further evidence of the remarkable flexibility and resilience of chemical enterprise but may also prove an indicator of future trends in general business.

MODERNIZATION IMPERATIVE

PROCESS INDUSTRIES embark on business problems in 1938 with more economic complications and more new social demands than ever before. Yet, technically, the course is reasonably clear. The main objective of the chemical engineer must be a lowering of production costs to offset the constantly rising pressure of new taxes, higher wages and increased costs of many raw materials.

One who has had unusual opportunity to observe the practical workings of economic law in our industrial system has recently said: "There is only one solution to the price problem and that is the preservation of the American competitive system and continuation of the crusade against waste and obsolescence. Every plant which eliminates waste, wipes out obsolescence, modernizes its mechanical operations and improves the efficiency of its methods. It protects itself against competition and puts itself in a position to sell at a lower price, thereby making available more things for more people, increasing production and employment and raising the standards of living. Wise management will pursue this policy rather than run the risk of the alternative course, which is to invite further governmental regulation and control."

New plant construction, which reached such satisfactory proportions last year, can scarcely be expected to continue on quite

the same scale during the current recession. The next few months will afford, therefore, more time for deliberate planning and careful development of projected work. Such consolidation of effort may really be welcomed by many who have had difficulty in adjusting present plants and processes to the growing demands of the past two or three years. No one welcomes a recession—much less a depression—yet if it brings with it opportunities for improving production efficiency, such valuable byproducts should be promptly recovered.

INDUSTRY ON THE MOVE

DECENTRALIZATION has been the keynote of much of the industrial migration of the past few years. How far is the trend likely to go? Thirty-seven of our forty-eight states are willing to gamble $5,650,000 to find out. Led by Florida with a fund of over a million dollars, these states are advertising their various attractions to industry. In addition, a number of industrial communities, power companies, railroads and regional councils are aggressively bidding for their share of new payrolls. Chemical process industries—notably pulp and paper, rubber and rayon —have been among the first to be affected and a large proportion of new construction has gone so far to the Southern States. But there is also a trend to the Far West that will be worth watching in 1938. Industry goes where it can find just one thing—profit.

RESEARCH CARRIES ON!

RESEARCH has always been well supported by process industries. Estimates of the amount of money spent on industrial research in all the laboratories of the United States during 1937 range between $88,000,000 and $110,000,000. Chemical and related metallurgical investigations consumed a major part of this total disbursement—perhaps between $75,000,000 and $90,000,000. Physical and mechanical investigations have required a sum approximating $20,000,000. For much of this expenditure, chemical engineering will be the principal agency for translating laboratory results into profitable plant operations through better processes, cheaper and better products, and new methods and materials—all making available new services to industry and to the ultimate consumer.

PROFESSIONAL PROGRESS

PROFESSIONAL ADVANCES in chemical engineering during the past year have been most encouraging. The guidance and selection of young men who are desirous of joining this profession have gone forward, and the recognition of the need for better training in our engineering schools is now widespread. A survey of engineering education, done under the auspices of the Engineers' Council for Professional Development, has been a most welcome and helpful influence in these directions. Many institutions hitherto a bit complacent are now valiantly improving staffs, curriculum, and facilities. Even those who were doing a good job before have been stirred to higher ideals by the self-analysis imposed during the accrediting surveys. The real need of 1938 is that more first-class teachers be discovered and persuaded to join staffs of institutions which are now able to spend a bit more on chemical engineering faculties than hitherto. It is the lack of dollars for faculty payroll that is most often the stumbling block.

Guidance of young men into or out of engineering studies is also an E. C. P. D. service just beginning to be appreciated. Active local committees are at work in New York City, Detroit, and elsewhere. The encouragement of proper professional recognition of all divisions of engineering will ultimately be of great advantage to every engineer as an individual. But it must not be forgotten that all of these efforts are really increasing the demands on the individual, raising the standards which he must meet, and compelling a continuance of study in self-training far beyond the closing of college days.

Training programs now undertaken by many companies often help to fill this need. But it is our observation that purely technical or "job" training can well be supplemented by participation in professional activities through the engineering societies or by affiliation with nearby university or college activities. After the formal training period is over the encouragement of proper reading and study habits will enable the young engineer to carry on his long-term program of self improvement. This is especially important in smaller companies where there is less opportunity for wide contacts with other than a man's immediate associates.

EXAMPLE AND COMPETITION

COMMENDABLE EFFORTS of E. C. P. D. to accredit basic engineering curricula have stimulated the organization of ceramic engineers under the auspices of the American Ceramic Society. Most chemical engineers will welcome this closely related and contemporary activity. Even those who have nothing to do with ceramic enterprise are glad that the engineering phases of that division of science and of industry are to be suitably encouraged and subjected to critical review. After the organization meeting the first of next April, it will not be too much to expect that suitable standards for ceramic engineering will be set up, both with respect to college curricula and individual achievement and practice.

The effort of consulting chemists and chemical engineers to advance their affairs to the highest obtainable professional status has likewise received favorable comment and compliment. All chemical engineers will give deserved attention to the several troublesome problems set forth in the recent report on unethical and unfair competition prepared by a committee of the Association of Consulting Chemists and Chemical Engineers. That agency very wisely raises the question as to the reasonable scope of scientific and technical work done by government bureaus and agencies. It also points to obvious and correctable difficulties where members of the faculty of edu-

cational institutions abuse or over-use their position or facilities in securing personal benefits from unethical types of consulting service. Even the sales organizations of our great chemical enterprises will want to note with care the suggestion that "sales service" has often gone so far as to amount to unwarranted competition with ethical consultants.

Hard and fast rules cannot be set up for any of these relationships, but progressive good sense applied to each problem should eliminate most of the difficulty and permit a solution of even the most troublesome problems of competition.

JAPAN'S RAPID RISE

AMONG THE CHEMICAL INDUSTRIES of the world, Japan's recent progress takes a leading place. Within ten years her alkali production has increased tenfold, having more than doubled even since 1933. Sulphuric acid, which is usually a good industrial barometer, has risen from 1,530,000 metric tons in 1931 to 3,360,000 metric tons in 1936. Present capacity is in excess of 4,654,000 metric tons of 50 deg. acid. Nitric acid production in 1936 was 78,500 tons as compared with only 7,530 tons in 1929. Other significant figures will be found in an unusually comprehensive report by the Department of Commerce which is summarized on page 56 of this issue.

What does all this mean? Is it merely mushroom growth from war demands or is there the basis for a permanent and lasting development? Our observation is that both influences are at work, but there can be no doubt about Japan's desire to attain chemical self-sufficiency. Eventually that means a loss of our export trade, not alone to Japan but to other countries where Japanese competition is certain to increase within the next few years.

PREPAREDNESS WITHOUT PUGNACITY

INTERNATIONAL RELATIONS have not in many years been more threatening of difficulty for the United States than during recent weeks. But good sense on the part of officials and the general public has relieved the strain immeasurably. No one supposes that this is a sign of weakness. Rather it is a sign of determination that the United States will practice in international affairs those precepts which it has preached and which it has accepted as treaty obligations.

Fortunately chemical industry is no longer accused of instigating warlike measures or encouraging international complications. Certainly officials, and apparently the public, too, are beginning to realize that those who must munition the nation in case of need are the last ones to want that responsibility or to do anything to create the necessity for military activity. There is even some hope that the public can understand that selling munitions abroad under export permits is not a jingoistic militaristic effort. Oftentimes it could easily be proved, if government officials were at liberty to speak frankly, that these minor activities are really a first line of American defense abroad. They have the sanction, at least indirectly, of the public authorities; and they should have the encouragement of contemporary industry and the public.

But all of this will not excuse that occasional exploiter of human misfortunes, who does disregard all proprieties of civilization in order to snatch a profit. There are a few such people, but they are not typical of nor welcome in the chemical industry. Preparedness without pugnacity is the sincere plan and desire of American chemical enterprise.

* * *

SO AS THE INDUSTRY AND PROFESSION move further into the new year, there is increasing obligation and opportunity for the chemical engineer. His primary responsibility is for more efficient production through improvement in process and equipment. Because he must guard and preserve the constantly narrowing margin between operating costs and selling prices, his interests are in economics as well as in technology. In fairness to himself and to those who are to carry on the future of chemical engineering, he must give some of his time and energy to the advance of his chosen profession. And, finally, because he is an educated and respected member of society and of his community, he has an obligation of good citizenship and unselfish service to his fellow men. All this seems a large order but one that can and will be filled by chemical engineers in 1938—recessions and reforms notwithstanding.

Sidney D. Kirkpatrick

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Chemical & Metallurgical Engineering is the successor to *Metallurgical & Chemical Engineering*, which in turn was a consolidation of *Electrochemical & Metallurgical Industry* and *Iron & Steel Magazine*, effected in July, 1906.

The magazine was originally founded as *Electrochemical Industry*, in September, 1902, and was published monthly under the editorial direction of Dr. E. F. Roeber. It continued under that title until January, 1905, when it was changed to *Electrochemical & Metallurgical Industry*. In July, 1906, the consolidation was made with *Iron & Steel Magazine*, which had been founded eight years previously by Dr. Albert Sauveur. In January, 1910, the title was changed to *Metallurgical & Chemical Engineering*, and semi-monthly publication was begun Sept. 1, 1915. On July 1, 1918, the present title was assumed and weekly publication was begun Oct. 1, 1919. Monthly publication was resumed in March, 1925.

Dr. E. F. Roeber was editor of the paper from the time it was founded until his death on Oct. 17, 1917. After a brief interim he was succeeded by H. C. Parmelee. Ten years later, Nov. 1, 1928, Mr. Parmelee assumed other responsibilities in the McGraw-Hill Publishing Company and was succeeded in the editorship by Sidney D. Kirkpatrick.

The editorial staff of the magazine comprises: James A. Lee, managing editor; H. M. Batters, market editor; T. R. Olive, associate editor, Robert L. Taylor and Melvin E. Clark, assistant editors. R. S. McBride and Paul D. V. Manning are editorial representatives in Washington, D. C., and on the Pacific Coast, respectively. [All rights to above magazine titles are reserved by the McGraw-Hill Publishing Co. 330 W. 42nd St., New York, N. Y.]

CHEMICAL ENGINEERING Trends IN PROCESS INDUSTRIES

RECENT

FOR THREE GENERATIONS the mastication, mixing and sheeting of unvulcanized rubber was conducted with no essential improvement in the methods originated by Thomas Hancock. It is little more than a decade since improved machines such as internal mixers and weftless calenders were adopted. This former lack of improvement in the processing of rubber is in sharp contrast with recent advances such as the installation of high-powered, screw-feed, jacketed Gordon plasticators delivering 5,000 to 9,000 lb. per hour of plasticated rubber. It has also been shown recently that rubber is softened during mastication as the result of inevitable oxidation favored by high temperatures. This discovery accompanied the adoption of the powerful plasticators, which in operation generate high temperatures and give uniformly plasticated rubber at lower cost.

The same discovery also led to the use of catalysts of the type, naphthyl-beta-mercaptan, to promote the oxidation of rubber during its mastication. As little as one-fourth of 1 per cent of this active chemical added to the rubber will halve the breakdown period, thus increasing the capacity of processing equipment without inducing continued softening beyond the desired point.

These two methods of plasticizing rubber have real merit and promise many advantages over former practice. They appear not to be competitive with each other.

Many improvements in the quality of rubber articles have originated logically in the processing division. Of these improvements, thorough dispersion of pigments in rubber is of the greatest importance. Careful study of the energy factors of the "reinforcing pigments" has effected closer controls in the selection of raw materials and in the handling of semi-processed stocks, and has thrown light upon the proper use of modern mixing machinery. The improved method of handling pellet blacks constitutes a specific trend in modern rubber technology typical of the progress which is being made in mill room procedures. For more than twenty years carbon black has been shipped in bags, with waste from the dissemination of dust in packing, shipment, storage, and mixing, and variability frequently resulting from absorption of moisture or of other vapors. The perfecting of processes by which most suppliers now make carbon black in pellet form and ship it in closed tank cars makes possible improved storage and handling of this commodity in rubber factories. The pellets, which are loosely bound assemblages of the pigment particles, are friable and readily disintegrate in the mixer to yield rubber compositions formerly made in a dirtier and more troublesome fashion.

Among pigments consumed in large volume by the industry there have been no recent developments. Channel black, the thermal decomposition blacks, clay, whiting, iron oxide and zinc oxide continue to be used in large quantities. There is a tendency toward diminished consumption of the high specific gravity pigments such as barytes, blanc fixe, antimony sulphide, and zinc oxide. However, the temporary popularity of a pigment is likely to be conditioned by factors such as the prevailing market for rubber, the esthetic appeal of white or colored goods as opposed to grey or black, the demands of the factory for workable consistency, and the frequent changes in organic accelerators and antioxidants, so that any statement of a trend is hazardous. Considerations of quality have led rubber compounders to incorporate thermal decomposition blacks and fine particle, surface-treated whitings into rubber compositions. Because of its activation of organic accelerators, zinc oxide continues to be used in more recipes than any other pigment. Increasing amounts of channel black have gradually been consumed to improve the abrasive wear, particularly of tire treads. New methods of production of titanium dioxide have resulted in greatly increased use of this pigment because of its superior hiding power for white stocks, where its use depends mainly upon its high refractive index. The introduction of improved organic colors of the phthalocyanine type[1], e.g., Monastral Blue, and of another class of the type derived from *2, 2'* dichlor benzidine and aceto acetic arylamide[2] is of interest because of their brilliance and permanence.

Synthetic rubbers have long been sought by chemists both here and abroad. Despite the failures of many former endeavors, synthetic rubbers are at present being fabricated on a fairly large scale. A resume of the commercial production of Buna in Germany which appeared in the New York *Times* of November 21, 1937, is supported by reports in the technical literature. Buna rubber has for months been specified in place of natural rubber in goods purchased by the German Government. The imposition of an import duty of 1¼ RM. per kilogram on crude rubber is said to be for the purpose of raising money for additional factories for synthetic rubber pro-

700-hp. Gordon plasticator weighing 80 tons. Supported by rubber vibration insulators

DEVELOPMENTS WIDEN INDUSTRIAL USES FOR RUBBER

By H. L. TRUMBULL
THE B. F. GOODRICH CO.
AKRON, OHIO

Dr. Trumbull has been associated with the rubber industry since 1919, prior to which time he was at Mellon Institute and in the U. S. Chemical Warfare Service. With the B. F. Goodrich Co. he has had charge of compounding in various departments and since 1922 has been manager of research for the company. Not only a competent chemical engineer and rubber technologist, Dr. Trumbull also has wide civic interests. Since 1933 he has served as president of the Board of Education in the town of Hudson, Ohio.

duction in Germany. The German Government hopes that within the year this production may attain a volume of 27,000 tons.

Buna, which results from the polymerization of butadiene, has been made available in several grades, each of which in some respects is said to excel natural rubber. Vulcanizates made from Buna N have superior abrasive wear and oil resistance, whereas Buna S, a more readily processed variety, in cured form gives excellent heat resistance. A third grade of Buna is superior to crude rubber for hard rubber stocks. The Russians are reported to be making synthetic rubber from alcohol. Published results show that their product is inferior to natural rubbers.

Anticipating by a few months the news of foreign synthetic rubbers, the combined researches of Father Nieuwland and the du Point investigators were reported in 1931. Starting with acetylene, the du Pont process passes through the stages of vinyl acetylene, its hydrogen chloride addition product—chloroprene, and then neoprene —a polymer of chloroprene. Not only is neoprene a close chemical homologue of rubber and of Buna, but in its vulcanized state it has many properties superior to the corresponding products derived from crude rubber. Eloquent testimony of its superiority is the fact that without government subsidy and in the face of an average selling price at least five times that of crude rubber, the du Pont Co. has enlarged its production facilities several times to meet the growing demand for this product.

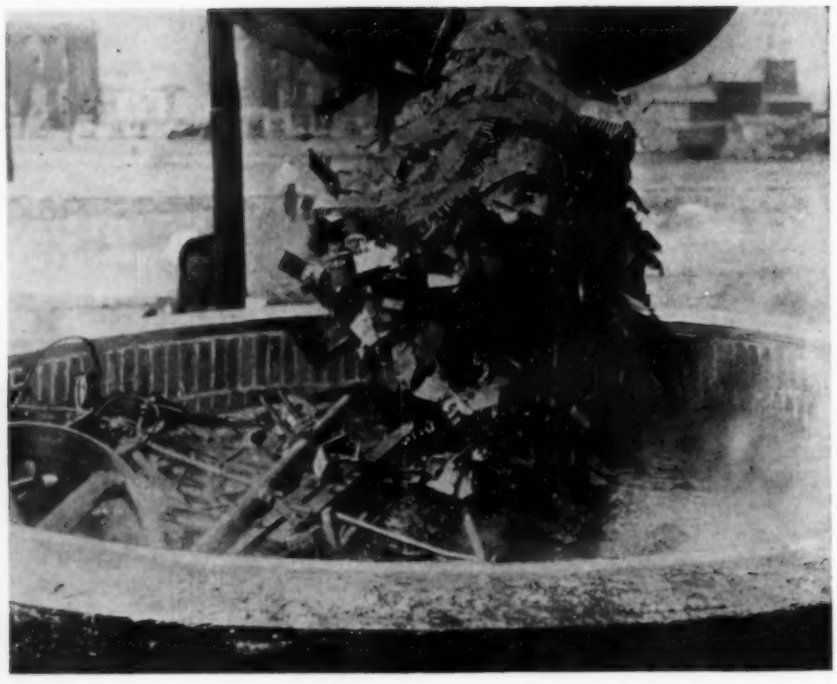
Neoprene lends itself readily to fabrication by conventional rubber processes. It is milled, mixed, calendered, extruded, and vulcanized as are rubber batches. Moreover, it can be blended in all proportions with rubber, an advantage of strategic importance. Vulcanized neoprene possesses high elongation, relatively high tensile strength, and parallels soft vulcanized rubber in its range of hardness, recovery, and compressibility. Neoprene has certain peculiarities in processing somewhat different from the peculiarities of rubber in respect to the choice and percentage of softener, control of plasticity, and the selection of vulcanizing agent. In regard to pigmentation, avoidance of scorching, and molding methods, procedures with neoprene closely resemble those with rubber. It cannot alone be used for hard rubber, but if added to hard rubber batches it confers flexibility.

Neoprene articles resist swelling and disintegration by oils and the destructive effects of corona and sunlight better than rubber. Composite structures in which the respective advantages of rubber and of neoprene can be embodied present interesting possibilities to those who are seeking unusual engineering materials.

The growing technology of rubber latex has acquired a versatile ally, the neoprene latices, which present the interesting variation that the suspended particles may be charged either positively or negatively as desired. Neoprene latices resemble Vultex in that the films are nontacky and behave like cured compositions.

The condensation product of ethylene dichloride and sodium polysulphide [3] was named Thiokol by those who sponsored its fabrication for sale to rubber companies. Several organic polysulphide structures have been made and sold to the rubber trade under different designations, e.g., Thiokol A, Thiokol B, Thiokol D, and Thiokol DX. These resemble each other much more closely than they resemble rubber or any other known plastic. Yet they

Tank of steel-rubber-brick construction for reducing scrap iron in hot HCl



possess properties which permit them, either with or without rubber, to be mixed with pigments, extruded, sheeted, and molded in a fashion similar to rubber goods. Such operations require hooded mills because of evolution of lachrymatory gases. In the hands of competent technologists Thiokol can be molded as are rubber goods, but the product will have only about half the elongation and tensile strength one is accustomed to find in the corresponding rubber article. Thiokol is noted for its limited swelling and disintegration in certain oils, solvents, and motor fuels. Thiokol A is reported to resist carbon tetrachloride, lacquer thinner, and turpentine. Various modifications resist ozone and sunlight, but none of them is recommended for use with strong concentrations of mineral acids or alkalies. The Thiokols consist largely of sulphur—over 80 per cent in some cases. If one sought to cure Thiokol by adding sulphur as in the case of rubber, he would not succeed. The contamination of rubber stocks by accidental inclusions of Thiokol is troublesome and presents more than one hazard.

Polyisobutylene has been offered to the rubber fabricator in a variety of molecular weights from 13,000 to 200,000. The viscous, tacky lower polymers may serve as softeners for rubber. Among the higher polymers are varieties which closely resemble pale crepe rubber in appearance and are soluble in the same organic solvents. These higher polymers differ chemically from rubber in not being unsaturated, and physically, in that they are much less responsive to the softening influence of higher temperatures. In the current developments in polymer synthesis they present interest from the structural viewpoint. They have been produced more extensively in Germany than in the U.S.A. They offer great interest to the rubber compounder chiefly because they share some properties with rubber and are chemically inert. The polyisobutylenes contain no sulphur and are odorless. They are reputed to be useful in modifying motor oils to minimize changes in viscosity with changes in temperature.

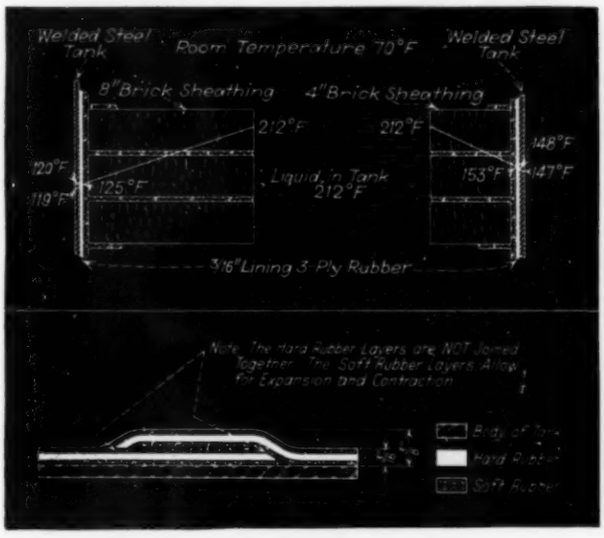
Compounding Ingredients

Two chemicals, thiocarbanilid and hexamethylenetetramine, which found early use as accelerators are being used in diminishing quantities, the present consumption of thiocarbanilid being almost negligible. The once popular guanidines are also being supplanted. The prevailing aldehyde amine type accelerator is polybutyraldehyde aniline, which shares with mercaptobenzothiazole and its derivatives the domination of the field. Both of these accelerators give good aging properties to rubber. Heptaldehyde aniline is a specialty accelerator most useful in light colored stocks to obtain freedom from staining. The derivatives of mercaptobenzothiazole comprise its reaction products, respectively, with formaldehyde, aniline, ortho toluidine, and urea, and its zinc salt either with or without fatty acid. These variants have been offered with the promise of less "scorching", a processing advantage not without merit. Yet it might be suspected that some of the derivatives were offered as the result of competition rather than because of superior merit.

The use of mixtures of accelerators to give delayed action, that is, safe processing, as well as to get faster and better cures, is proving more and more important. A parallel development is the use of anti-scorching agents, of which benzoic, salicylic and phthalic acids deserve mention. These retarders have a general retarding action upon the rate of vulcanization at all temperatures. Hence their use requires discriminating judgment. Critical study of acceleration has been mainly responsible for the remarkable improvement of rubber compounds subjected to severe heat in service. Conveyor belts containing these improved compositions stand up in heat

service four or five times as long as former grades and are retired mainly because of fabric failure. Perhaps the most significant trend in accelerators has been the intelligent choice of a few satisfactory chemicals to the exclusion of the others, scores of which have been offered for sale.

Recent changes in age resister practice have not altered appreciably the total tonnage consumed, for which definite statistics are not published. These changes comprise a trend away from the former aldehyde amine types and rather definitely toward those types which confer some function in addition to good aging by accelerated tests. For example, the chemicals which are in use to protect rubber from flex cracking are derivatives of diphenylamine. Although the latter is an age resister of questionable merit, its commercial derivatives—the p-anilino, p-isopropoxy, pp′-dimethyl, and pp′-dimethoxy —are powerful protective agents of rubber against flexing and oxidation. Certain closely related structures, acridanes, are also excellent in this respect. The ketone-amine reaction products comprise examples which confer good flex resistance and heat resistance upon rubber. Phenyl beta-naphthylamine, a good general purpose protective agent, has predominated in tonnage.



Above—Temperature gradient through wall of steel-rubber-brick tank. Below—Detail of 3-ply expansion joint in rubber lining

Chemists recognize at least five types of aging in rubber, all resulting from oxidation: static exposure to oxygen, aging from fatigue (stretching, bending), from heat, or from sunlight and ozone oxidation. Efforts to protect rubber from the first three have been more successful than from the last two influences.

Chemicals are known which protect rubber goods against oxidation without producing excessive staining in sunlight. Di-beta-naphthyl p-phenylene diamine, an excellent antioxidant, has been used widely for this purpose but is not entirely free from staining. Several other chemicals not inducing stain but with almost no oxidation protection have been sold. Recently, new chemicals such as p-benzyloxyphenol have been marketed which satisfy the combined requirements.

Commercially, most importance attaches to those protective chemicals which retard flex cracking in articles such as tires, belting, and soles. Next in importance is probably shelf aging, which is controlled by general purpose antioxidants.

Finished Rubber Products

Reliance upon research for the development of new products, processes, and compositions is well defined in the rubber industry. Of interest to all process engineers, certain new rubber products are of strategic importance to the chemical and metallurgical industries.

Protective coatings of rubber prevent both the corrosion of metals and the contamination of contacting chemicals, as, for example, in electroplating equipment. The improvement in the adhesive bond has permitted rubber-lined equipment to be used at steadily increasing temperatures, even in vacuum service. Because of freedom from corrosion, rubber-covered metal springs retain flexibility and give longer life. Ball and rod mills lined with rubber last longer than unlined mills and the linings protect their contents from those contaminating ingredients which originate in the metal walls. For certain types of service, rubber linings reduce contamination, increase output, prolong the life of the mill and its grinding elements. Rubber-lined ball and rod mills are used for pulping paper and in grinding gold quartz. Due to the diminished contamination by iron in the latter use, an interesting economy of cyanide in the next step is effected.

Rubber bearings functioning by water lubrication are installed to support the shafts of boats, turbines and dredges, of impellers used in paper mills, and of agitators in dye vats. Frequently the service is such that conventional bearings and lubricants must be avoided, or if used, present difficulties in installation.

The excellent adhesion of rubber to metal obtainable by special processes has promoted many improvements of particular benefit in the storage and handling of chemicals. Of greatest importance is the recent development of rubber-lined tanks comprising the adhesion of a three-ply hard and soft rubber layer to metal, with brick sheathing inside the rubber lining. The sandwich of hard rubber between two soft rubber layers distributes impacts and reduces penetration by gases and liquids, thereby lessening chemical action upon the whole structure. Since these linings are installed and vulcanized in place at the plant where they are to be used, the size of the tank is not a barrier to successful installation. Novel expansion joints as part of the three-ply construction prevent expansion and contraction stresses from cracking the hard rubber or causing separation of the lining. The inside sheathing of brick gives decided advantages in the handling of corrosive liquids under severe conditions of temperature and mechanical abuse. These advantages include the protective action of rubber, the resistance of brick to gouging and to chemicals, and, because of the high temperature gradient between the inner faces of the brick and the metal, additional protective action to the rubber-metal interface, thus insuring longer life and low maintenance.

Rubber compounds afford adequate protection for the transportation, storage, and handling of solutions of most inorganic acids except nitric and chromic, solutions of inorganic salts and alkalis up to the saturation point,

and a wide range of organic materials including acids, ketones, aldehydes, alcohols, vegetable oils, soaps, milk, fruit juices, dyestuffs, casein, glue, and aniline hydrochloride.

Rubber Derivatives

Although chlorinated rubber has been marketed by three rubber companies in past years, it has been sold recently in the modified form "Tornesit," mainly as a paint to give protective coatings.

Isomers[4] of rubber have been known for more than a decade within the industry but not until recently have commodities comprising largely such isomers been marketed. Variation in the composition of the isomers adapts them specifically to serve various purposes. They are sold as the Plioform molding plastics, the Acidseal paints, and the Pliolite paints. Paints from rubber isomers are unique in respect to alkali resistance and are being sold in increasing quantities because of their superiority in specific services, such as the protection of equipment, piping, and plant structures against corrosion. They have been used for inside wall and mill paints effectively. They may be applied by spraying, brushing, or dipping. Technical information concerning their use should be sought from the supplier to insure the best results.

Rubber hydrochloride, until recently a neglected derivative of rubber, has rapidly grown in use as the basis of a new line of adhesives and, in the modified form of Pliofilm, as a transparent, tough, plastic. Available in continuous rolls of sheet for uses such as packaging, it is said to be excellent for this purpose since it combines low water penetration, conformability, and heat-sealing features. It is a fabricating base for raincoats, shower curtains, garment bags, etc., and imparts to paper when plied with it a moisture sealing attribute. Incidental to the fabrication of Pliofilm, the largest solvent recovery project in the industry was required.

A recent advance of interest to the processing industries is the production and fabrication of Koroseal, a synthetic composition in many respects resembling cured rubber. The hard, insoluble gamma polymer of vinyl chloride undergoes a surprising transformation when masticated with plasticizers as can be done conveniently with rubber-mixing machinery. The plasticizers also function in differing degrees as elasticizers to give coherent batches which are sheeted as is rubber from the mixing rolls. In this form the stock can be calendered, extruded, press molded and fabricated into formed articles. The contrast to rubber in some of Koroseal's other properties is important and significant to the processing engineer. It does not require vulcanization to give it elasticity. It withstands long exposure to ozone and oxygen, and is practically unchanged after two years in sunlight. It is more inert than rubber to the action of corrosive chemicals, even withstanding prolonged immersion in chromic or concentrated nitric acid. In mineral oil it differs from all other rubber-like plastics in that it does not swell. It shrinks slightly after long exposure. Its incompatability with rubber is surprising, since the other newer plastics resembling rubber are compatible with the latter in nearly all proportions.

Among its applications are tubing, roll covers for the textile industry, diaphragms for pumps and motors, valve disks and seats, gaskets, pipe coverings, steam injectors for acid and alkali tanks, flame-proof and ozone-proof protective coverings for electrical cable, direct electrical insulation, and as ply coating for fabric beltings. In the form of Korogel it serves ceramists in protecting their ware during decorating operations and as a casting jelly for the fabrication of ceramic ware molds. It is also available in cement form for proofing textiles and paper. Korolac is a cement form marketed primarily to electroplaters who employ it in a dipping procedure to apply protective coatings on such articles as plating racks.

Latex Technology

Importation figures reveal that the requirements for rubber as latex, although much smaller than for crude rubber, are increasing at a much faster pace.

Latex compositions are being used to furnish linings of rubber for electroplating and caustic tanks.

In specially prepared forms some of which are proprietary, latex of sprayable consistency is used widely to give protective films of rubber over the surface of articles that are liable to be soiled, stained or corroded in shipment. White sidewall tires, auto trim, plated ware, etc., thus protected reach the consumer in undamaged condition and the coherent film of rubber is easily stripped off in one piece.

Whipped latex compositions are being cured into porous structures usually molded in cellular patterns for upholstery use. A marked advance in the fabrication of this type of sponge composition in this country has occurred within the last few months. Work done in England by the Dunlop Rubber Co. anticipated and stimulated the American development.

Finely porous sponge structures of hard rubber are being derived both from latex and from crude rubber to give products resembling filter plates. These are finding rather widespread use as battery separators and are recommended as filtering devices because they withstand a wide range of corrosive chemicals.

In the field of latex fabrication, thread rubber probably constitutes the most interesting basis of recent commercial progress. One method of fabrication resembles rayon technology, comprising extrusion of thin, continuous streams of latex through fine orifices, followed by coagulation, drying and vulcanization. Other methods such as cutting sheets made from latex into fine threads for the textile trade are also in use. Latex thread is finding further use in making elastic webbing and for golf ball manufacture.

Another process deserving of mention is the Kaysam Process of casting articles in suitable molds from specially prepared latices.

Progress in the improvement of process and the origination of new products in the industry is becoming the direct responsibility of competent technical men who are employed in large numbers to insure these accomplishments. The results of their efforts have been but imperfectly summarized in the above discussion. It is hoped, however, that this resume will serve to direct the attention of those who are responsible for progress in the other processing industries to the vital importance of rubber in serving their requirements.

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TRENDS IN INDUSTRIAL FINISHES

By WM. KRUMBHAAR
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The author of this article is one of the outstanding authorities of the world in rapid drying surface coatings for the protection of metal, wood, leather and other articles. For many years he was director of research for the German paint and varnish manufacturers' association. In 1929, he joined Beck, Koller and Co. of Detroit and later became an officer in that organization. He has recently returned from a several months trip around the world on which he investigated problems in connection with the production and marketing of protective finishes

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AMERICAN INDUSTRY is pioneer and leader in methods of industrial mass-production. The majority of all mass-produced articles, whether made of metal, wood, fabric, leather, paper or other material, need protective coatings, and it was only by the development of rapid drying surface coatings, i.e. synthetic finishes, which are dried in ovens at elevated temperatures, that mass-production of such objects was made possible. The speed of production is being increased constantly, and the properties of the protective surface layer improved, both speed and quality requiring coating finishes which dry quicker to a harder and more resistant film which has better color and higher gloss. This trend in industrial finishing, especially during the last two years, has been due to new heat drying resins of the phthalic type which form the base of such synthetic surface coatings.

The new trend will be demonstrated by a few examples taken from the field of automotive finishes, of coatings for metal furniture and tin decoration, of refrigerator enamels and nitrocellulose combinations.

The bulk of all mass-produced and industrially finished articles are made of iron. Finishing enamels for these purposes usually are not put on the metal directly but the bare metal is first covered with a priming coat. Originally, the binder for this type of coating was based on oleo-resinous compositions, consisting of natural resins and oils, because contrary to synthetic resin solutions, only this type of vehicle imparted sufficient adhesion to the sometimes greasy metal. Since the metal surface can be properly prepared by acid phosphate treatments, and synthetic resin coatings with good adhesive properties have been developed, the liquid vehicles of priming finishes are based on these resins. The result has been quicker and harder drying finishes of good adhesion and high chemical resistance.

The resins used for this purpose are highly resinified glycerol-phthalates, chemically combined with the glycerides of drying oil fatty acids, like those of perilla or tung oil. Recently, further modification by phenolic components, such as the butyl phenol dialcohol, has proved beneficial on account of greater water resistance. This property is of special importance to anti-corrosive primers for light alloys, which are invariably pigmented with zinc chromate; furthermore, it is important for white primers used as the undercoat for modern refrigerator whites which, after baking, must stand the test of being immersed in boiling water for one hour.

Water resistance is likewise paramount in undercoats for automobile body work. Under practical conditions, the first coat is a so-called primer with a low pigment content of about 20-25 per cent, followed by a primer-surfacer with a medium pigment content of 40-50 per cent. Straight surfaces, which run higher in pigment, have been abandoned recently in favor of the better adhering primer-surfacers. The pigments used are mixtures of slate flour and iron oxide, also talc and white pigments; small additions of zinc oxide, red lead, diatomaceous earth and carbon black usually being made to improve surfacer characteristics.

Chassis blacks require the same water resistance as automobile undercoats and, therefore, are also based on

Solvent storage tanks at the Detroit coatings plant of Beck, Koller & Co.

solutions of phenol modified phthalics. To accelerate drying, the proportion of oily component is often reduced by the addition of cold cuts of brittle resins.

The modern trend in industrial finishing is shown most spectacularly in the development of automobile finishing enamels. The assembly lines, delivering a complete automobile each minute, made imperative a rapid drying coat which at the same time possessed all the weather resistance required under practical conditions. This problem seemed illogical to the old fashioned paint men who could not believe in the durability of quick drying finishes, being prejudiced by experiences with oleo-resinous varnishes. The problem was finally solved with the help of nitrocellulose finishes, their solid content being increased by suitable synthetic resins. Normally, about equal amounts of nitrocellulose and resin are present in the enamel vehicle, together with a small amount of plasticizer. The resin used is a glycerol-phthalate modified by fatty acids of the non-drying type, outstanding for perfect compatibility with nitrocellulose.

For purely practical reasons and in order to avoid patent litigation, there has always been a tendency to increase the resin addition at the expense of the nitrocellulose, leading finally to a complete elimination of nitrocellulose in coatings for the low-priced cars. The straight synthetic enamel vehicles are based on phthalic resins, which are phenol modified in order to obtain highest possible water resistance.

The Ford plant in Detroit quite recently started large scale tests for drying and baking of car finishes by simultaneous action of light and heat. The cars travel through tunnels or in moving ovens, which are equipped with thousands of electric heat lamps of 260 watts each, and so arranged that their light and heat irradiation can fully act upon the finishing enamels previously sprayed on the surface of the automobile bodies. The same principle of forced drying has been in use for repair work for some time, the finishing enamels being sprayed on the particular spot of the body and dried under a lamp.

Mass-production of metallic articles covers a wide field with an ever-increasing variety of finishes required. Fortunately, phthalic resins can be sufficiently varied in composition and properties to meet these requirements. All phthalic resins used today have been modified either by an oily component alone or together with phenolic resins. Sometimes the phthalic anhydride is replaced by other dibasic acids of high molecular weight or long chain structure, resulting in resins of high elasticity and excellent adhesion. The oily component in phthalic resins varies according to type and amount of fatty glycerides present. Non-drying, semi-drying and drying fatty acids are used and the proportion of glycerol phthalate to oily component varies from 2:1 to 1:2.

The film forming characteristics of phthalic resins vary with their composition. Resins of nearly every type and combination of physical and chemical properties required for practical purposes can be produced today. Phthalic resins modified with non-drying oils, for example castor oil, are designed for combination with nitrocellulose in industrial lacquers. Non-drying types with high oil content are excellent resin plasticizers. They keep their elasticity even at low temperature. The cold resistance obtained thereby is an important step forward in developing finishes for such metallic articles as milk cans, which at times are exposed to sub-zero temperatures .

Phthalic resins modified with semi-drying fatty glycerides, such as soybean oil, are advantageous for industrial finishes which must retain their color and flexibility although baked at high temperatures. Because of these characteristics, semi-drying resin types are preferred for car finishes by some automobile manufacturers.

Most phthalic resins used in industrial finishing are the drying oil modified types. Industrial baking enamels for metal furniture for office or household purposes are examples. Originally, they were formulated exclusively with the help of phenol modified phthalic resins because of the versatility and foolproofness of these resins. Quite recently, however, non-phenolic oil modified phthalics have been coming into use also, especially for paler colors. Their tendency to wrinkle or gascheck during baking, if applied in thicker layers, can easily be overcome by additions of straight phenolic resins of the complex phenol type and by using the right amount and type of drier.

The wrinkling tendencies inherent in some of the pure oil modified phthalics render them suitable for the formulation of wrinkle finishes, which nowadays are seen on so many articles. To produce the effect, an overdose of drier is necessary, together with sudden application of high baking temperatures.

Another interesting field of industrial metal finishing, which has gained considerably by new resin developments, is that of tin-decorating enamels. Shorter drying times at lower baking temperatures with correspondingly better color retention is obtained by applying resin types in which the phthalic acid is partially or completely replaced by a high molecular dibasic acid. Probably due to the molecular structure of these acids the resulting resins have an unusually high degree of elasticity, unobtainable formerly but indispensable for modern tin-decorating finishes which often are subjected to severe tooling, as for example in the case of bottle caps.

Another important property unobtainable formerly and

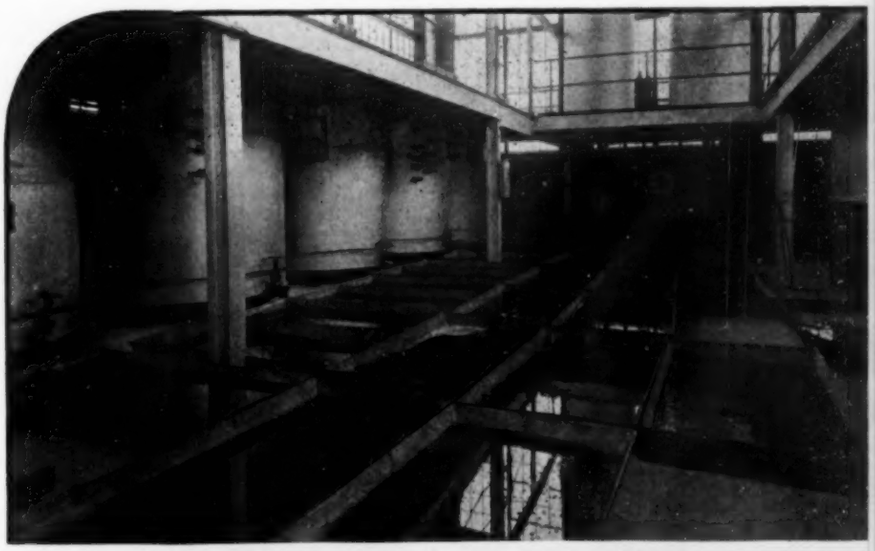
produced today is high water resistance, which is required if the tin finishes have to be pasteurized in boiling water. For this purpose the phthalic resin enamel film is fortified by a phenol curing treatment. To the enamel vehicle is added a cold cut of a straight phenol dialcohol resin which, at baking temperature, reacts with the phthalic. Under such conditions, resistant films are produced, because the film is formed not only due to the heat conversion of the phthalic resin but also due to the linking action of the phenol dialcohol, which creates high molecular stable substances of probably ring-shaped structure.

Modern phthalic resin enamels originated in a factory for refrigerators, where it was discovered that they came closer to the old approved vitreous enamels than any other finish. It took years, however, to find out the right types of resins, which, in combination with titanium dioxide and zinc oxide, were capable of yielding glossy pure white enamels if baked at temperatures higher than 250 deg. F. In this work, the interesting fact was established that linolenic acid, applied as such or with the modifying agent in the base resin, causes discoloration and, therefore, has to be avoided. It was also established that the presence of substantial amounts of zinc oxide in the pigment is essential for an enamel-like drying and appearance of the coating. Therefore, especially neutral types of phthalic resins, compatible with zinc oxide, had to be developed for this purpose.

However, up until a year ago refrigerator enamels still lacked a perfect scratch- and mar-proof condition immediately upon removal of the finished object from the baking oven. Following the general trend to quicker and harder drying industrial finishes, the problem of mar-proof enamels has been solved by the introduction of urea-formaldehyde, or, speaking generally, amine resins. Their use had been limited formerly due to poor gloss and water resistance. After the elimination of these and other defects, it became possible to produce urea-formaldehyde resins for baking enamel finishes which have all the good properties of vitreous or porcelain enamels without the drawbacks, especially without any brittleness. In many cases, as for instance for modern refrigerator white enamels, mixtures of chemical combinations of phthalic and amine resins are applied.

The new trend in industrial finishing for higher speed and better, more versatile coatings has also had its effect on the development of nitrocellulose lacquers. The possibilities resulting from combining nitrocellulose with synthetic resins were recognized some time ago, but were only fully exploited recently. Three different types of synthetic resins are in use, the maleic acid resins, the non-drying phthalic resins and the drying types of phthalics. By combining maleic acid resins of high melting point with nitrocellulose, hard films are obtainble which are capable of taking a high polish. Sanding sealers and wood furniture lacquers are based on such combinations which can be varied in many ways. Film properties can be adapted to special purposes much more easily now than formerly. The same holds true even more so for combinations of nitrocellulose with oil modified phthalic resins. If less than two parts of phthalic resin is incorporated with one part of nitrocellulose, usually the non-drying types are chosen; if the resin ratio is higher, drying phthalics are preferred. The proportion of drying resin may be increased to an extent that the composition rather resembles a phthalic resin finish than a nitrocellulose lacquer. By varying the type and amount of resin used together with nitrocellulose, finishes of every possible description can be produced for application on paper, fabrics, leather, floor coverings and other materials for which, formerly, suitable surface coatings were not available.

Industrial finishing comprises an enormous variety of objects, but the few examples given here show the general trend in this field which was made possible by the use of synthetic resins. These materials actually have speeded up industrial manufacturing processes and have made possible mass-production with the result of better and cheaper articles accessible for a wider realm of people.



Above—Resins are prepared in the kettles and drawn off into the pans to cool. Below—Kettles used for melting copal resins in the Detroit plant

Cellulose Situation D

By WILLIAM C. McINDOE
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Mr. McIndoe completed his undergraduate work at Harvard in 1918, obtaining his M.S. at the University of Washington in 1922. A short teaching period preceded his industrial experience which included engineering work in the gas industry, research on petroleum products, and production chemistry in the manufacture of cellulose acetate rayon. Most recently he has been associated as assistant chemist with the U.S. Army Engineer Corps, engaged in the study of Pacific Coast industrial chemical possibilities, with particular reference to the application of power from Bonneville Dam.

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ANOTHER YEAR'S ACCOMPLISHMENTS are about to be spread on the record, subject, of course, to minor correction as to accuracy; but, in the main, the bold outlines of achievement can be discerned now. The rayon industry has advanced steadily in spite of the year's financial, industrial and labor turmoil. Domestic consumption stays out ahead of production, forcing many producers into accelerated building programs. Normal and artificial stimuli—Government subsidies and foreign events—have been impeded in effectiveness somewhat by delays in receipts of raw materials owing to maritime and lumber industry labor troubles and difficulties in financing. Even with these hindrances the 1937 United States rayon yarn production, exclusive of staple fiber, has been estimated by *Textile World* to be 325,000,000 lb. with 20,000,000 lb. of the staple fiber to boot. As distinct from the staple production, the yarn production lagged behind earlier predictions; but only slightly.

Domestic staple fiber production made an estimated 61 per cent increase over last year to touch about 20,000,000 lb. Add to that importations to the extent of 27,000,000 lb. more. Consumption of staple fiber in the United States has risen swiftly from the 54,000 lb. of 1928 to the 47,000,000 lb. of 1937. The facts that this cut fiber can be spun and otherwise handled on cotton, silk and woolen textile machines to give interesting novelties in weaves and mixtures are responsible for its rapidly increasing popularity. Versatile spun rayon (short lengths of staple fiber twisted or spun into thread, 1- to 2-in. lengths for cotton spinning and 2- to 7-in. for silk and woolen spinning), as described by the Viscose Co., "is like cotton, but different; it is like wool, but different; it is like silk, but different. It makes fabrics with all the appearance of linen, but still with intriguing difference."

In the world at large, the staple situation differs markedly. Certain European and Asiatic nations, principally Germany, Italy and Japan, without adequate domestic resources of the recognized pulpwood types and haunted by the fear of war blockades drying up outside supplies at their borders, are strenuously seeking self-sufficiency through research into the pulping properties of all forest types, as well as grasses and the stalks of field crops. Their aim is independence of American cotton through development of staple fiber as a cotton substitute. Government subsidies in these countries are pushing manufacturers into large production of staple. In 1936 these three nations produced 80 per cent of the world's 275,000,000 lb., while the United States produced only 4.5 per cent. 1937 figures for world production are not yet available.

From the beginning the domestic rayon industry has been and is still using both cotton linters and wood pulp for their source of cellulosic raw material. At first staple cotton was used but with the introduction of pressed cottonseed products linters became the chief reliance. The balances between pulp and cotton have waxed and waned. The nitrocellulose, cuprammonium, and cellulose acetate processes began with 100 per cent cotton and stayed so up to several years ago; whereas, the viscose process began with 100 per cent wood pulp but has blended in as high as 50 per cent cotton linters. By 1936, however, this percentage has receded to about 30 per cent average and is still falling. (At present, several viscose producers are using 100 per cent wood pulp while others are still employing about 30 per cent linters.—Ed.) Now the cotton nitrators are reported to be turning to wood pulp and successful cellulose acetate prepared from wood pulp is on the market. Let us look for the reasons underlying this "criss-cross play."

Why Pulp Is Gaining

Cotton linters, although darker in color than staple, has the highest natural α-cellulose content known. It has been blended with wood pulp in the viscose process to improve elongation, strength and color of the softer wood pulp yarn produced, but recent research in pulping and bleaching methods has largely wiped out this advantage of linters over wood pulp. Indeed, 100 per cent cotton would not make satisfactory viscose in any event. Furthermore, the wild fluctuations of the cotton market, plus the artificial high prices maintained by Government market manipulation and bonuses to encourage scarcity, have turned the attention of the rayon industry and associated cellulose lacquer and plastics industries to the normally lower priced, more plentiful, and much more stably priced wood pulp which has not as yet been subjected to manipulation. Visible supplies, as well as comparative annual growth yields, also favor this strong trend toward wood pulp.

Spruce bleached sulphite pulp is being supplied from

n Dominates the Rayon Scene

New England and Eastern Canada; southern pine from the Carolina-Georgia-Florida area; and western hemlock from the states of Washington and Oregon and from British Columbia. The New England states and contiguous eastern Canada have been largely logged-off and primarily only the scattered wood-lot type of operations remain. Therefore, these states are importing their raw pulp from Canada and Scandinavian countries; and Canada is expanding her logging activities northward. Also, New England and Canadian rayon pulp mills, under pressure of the necessity of going farther afield for their sources of spruce for pulp, have been investigating other wood species as possible substitutes. The success of pioneering efforts by the Brown Co. of Berlin, N. H., was announced in October, 1937. The company reports it is now producing a high quality sulphite pulp from hardwoods such as maple, birch and beech. The present daily production of this pulp is said to be approximately 200 tons, of which more than half enters the rayon field. These hardwood species grow more rapidly than spruce, thus bringing replacement crops in a shorter span of years—but the logging operations will remain of the wood-lot type.[1]

Dr. Charles H. Herty's research at Savannah, Ga., into the pulping properties of southern slash pine has made that species available for both newsprint and rayon.[2]

Since 1929 rapidly increasing quantities of western hemlock bleached sulphite pulp from the state of Washington have gone into rayon, until today more than 40 per cent of the domestic consumption is western hemlock. Rayonier, Inc., the recent merger of Rainier Pulp & Paper Co., Grays Harbor Pulp & Paper Co., Olympic Forest Products Co. and Shaffer Pulp Co., is responsible for this development.

In 1936 there were 70,490,000 cords of standing pine on 17,348,000 acres in Georgia, South Carolina and Florida from about Georgetown, S. C., to 40 or 50 miles below Jacksonville, Fla., in a 100-mile wide strip stretching in from the coast.[3] Western hemlock grows principally along the Oregon and Washington coasts in a narrow but dense belt about 25–40 miles in width, from sea-level to about 1,500 ft. elevation On an area of 2,740,522 acres stands 279,678,800 cords of western hemlock, measuring from 4 in. DBH (diameter breast high), to over 20 in. DBH, all available for cutting.[3] The areas predominately Sitka spruce, balsam fir and mountain hemlock swell these pulpwood totals considerably.

A comparison of the productivity per acre of different wood species and of cotton linters definitely favors the wood pulps as sources of cellulose, and indicates inherent guarantees of future supplies. According to Hoff,[4] in 1935 about 30 per cent of the raw material going into rayon was linters. This meant that 75,000,000 lb. was required that year, taking up the linters production of 4,700,000 acres at the productive rate of 16 lb. per acre per year. Contrasted with this, the current annual growth of southern slash pine is 1 cord per acre, or 86 cu. ft. (see Lodewick, *Pac. Pulp & Paper Ind.*, Sept., 1935), or about 1,000 lb., which checks the 1935 Canadian figures for spruce.[5] On the other hand, western hemlock has a current annual growth of 178 cu. ft. per acre, or about 2,100 lb.[5] One short ton of pulp is produced from 2 cords of wood, western basis, while 2 cords is claimed by Dr. Herty to yield 1.17 ton.

The price structure also favors the trend to wood pulp. During 1935–1936, unbleached linters was priced at $70–$90 per ton, f.o.b. processing centers; i.e., the gin. Bleaching and freight were extra.[6] In 1935 bleached sulphite spruce pulp for rayon sold for $70 per ton, f.o.b. Three Rivers, Canada, for an 86 per cent α-cellulose content. Freight was $8 per ton to Rome, Ga. Dr. Herty claims[2] that he can produce bleached sulphite rayon pulp from southern slash pine for a cost of $35.22 per ton with an 89 per cent α–cellulose content. In 1936 Rainier Pulp & Paper Co. and associates were selling a 90 per cent α–cellulose bleached sulphite pulp from western hemlock for $70 per ton, f.o.b. their mills at Shelton, Port Angeles, and Hoquiam, Washington, shipping by water to Atlantic ports for $6 per ton.[6] Effective April 1, 1937, domestic prime bleached sulphite pulp was quoted at $58 per ton ex dock Atlantic seaboard for contract customers. The 1938 contract price for rayon pulp is stated by *Pacific Pulp and Paper Industry* to be $95 per ton f.o.b. mills.

Pulp From West and South

The foregoing discussion of the trend away from linters toward wood pulp discloses another trend—a geographical one to newer and more abundant sources for the wood pulp. Dr. Herty[3] has pointed to the pulps from southern slash pines of South Carolina, Georgia and Florida as satisfactory for rayon. (See also *Chem. & Met.*, Feb., 1937, p. 94.) It is indeed significant that Rayonier, Inc., whose component concerns were responsible for the swiftly increasing success of western hemlock rayon pulp, are the first to act upon Dr. Herty's findings. This company is building a $6,000,000 mill at Fernandina, Fla., to produce rayon pulp from southern slash pine by a special process of its own developed entirely independently of Dr. Herty's work.[7]

The lowly western hemlock, which even had laws passed prohibiting its use as lumber on account of its tendency to check and warp, produces the excellent rayon pulp of 89–93 per cent α–cellulose content now so in demand both at home and abroad. At present the four associated pulp mills in the state of Washington are making it with a combined output of about 780 short tons per day or 232,000 tons per year (310 days), which is equivalent to about 464,000 cords of wood.[6] Eight other pulp mills in Washington and Oregon are using western hemlock with a combined capacity of 1,170 tons of pulp daily, or 368,700 tons yearly, at present going into the manufacture of the finer grades of paper. In addition,

two mills in British Columbia are now making a rayon pulp from western hemlock.

Should rayon pulp become a more attractive market than paper, a partial switch of destinations would be in order. Incidentally, it is reported that some 40 per cent of the 1936 rayon pulp requirements, or slightly under 50,000 tons, was produced in the Pacific Northwest. Furthermore, the industry operated at capacity levels during 1937.

It is interesting to speculate on an additional potential rayon pulp source for which an "if so, why not?" case can be made. If southern pine can be used for rayon pulp, so also can the Douglas fir of the Pacific Northwest, or, more specifically, the present and future logging and milling waste. Suitable pulps have actually been prepared in commercial quantities both by regular and by modified processes, yielding α-cellulose contents from 87.5 to 94.2 per cent. Estimates indicate that the potential supply of pulp from this source might be as much as 1,700,000–2,000,000 tons annually were all mills so situated as to be able to avail themselves of this supply.

It is significant that a sizable Government grant to the University of Washington has just been made for the purpose of studying possible rayon pulps from Douglas fir.

Rayon production has increased so fast that it has far outstripped the spruce pulp supply, thus leading directly to the present intensive investigation of the suitability of other species and to the geographical shift from New England and eastern Canada. This study has led to a trend away from the orthodox, standard sulphite process, in spite of positive statements made in 1929 that only the sulphite process yielded a suitable pulp and that the sulphate and soda processes *never* could be used. This belief, of course, guaranteed initial study of the sulphite pulping of other species; but soon rumors and announcements of so-called "modifications" of that process began to appear. Now improvements in bleaching methods have refocused attention on the ignored sulphate process. Commercial quantities of a bleached kraft (sulphate) pulp of very high α-cellulose content are reaching the market. This pulp, reported to be suitable for rayon, has an analysis of 95.5 per cent α, 0.5 per cent β and 3.5 per cent γ cellulose, with ash of 0.1 per cent and a copper number of 1.0 (Shera, *Pac. Pulp & Paper Ind.*, Dec., 1936; Hatch, *Pac. Chem. & Met. Ind.*, Sept., 1937).

Rayon Process Trends

A study of the world and United States production balances between the three most prominent commercial processes, viscose, cuprammonium, and cellulose acetate, reveals the continuation of a strong and steady trend toward the cellulose acetate process. Although still increasing on a poundage basis, the viscose and cuprammonium processes are losing valuable ground on a percentage basis to the cellulose acetate type. Qualified observers have been predicting the continuation of this trend, if not a speeding up of this swing to acetate (Hatch, *ibid.*). From a 3.2 per cent share in United States production in 1925 compared with viscose's percentage of 85.7 and nitrocellulose's and cuprammonium's combined percentage of 11.1, acetate has surged ahead to a mean of 23.5 per cent for the first half of 1937 while the combined viscose and cuprammonium percentage dropped to 76.5. In 1936 cuprammonium alone made approximately 3.5 per cent of the domestic production. Undoubtedly, with much cheaper acetic acid promised in the very near future, the acetate process will continue to score large gains. Production records alone are not the only evidence of this trend toward the acetate process. Examination of the research and patent literature reveals the fact that the vast preponderance of work being done is on that process.

What are some of the reasons for this trend? Stripped to bare essentials, the acetate process is truly a "triple threat" proposition, because any or all of three principal end products can be produced by the single plant. If the spinning solution is extruded through small holes, the product is yarn; if through a narrow slot, it is transparent sheeting, or the middle binder or lamination for safety glass, or safety base of photographic film; but if precipitated in granular form, it becomes the molding powder for a very successful line of molded plastics. Further, dissolving this granular cellulose acetate in the proper solvents yields excellent cellulose lacquers. It is of some interest to note that in 1936 there were 26 makes of automobile using cellulose acetate plastics for steering wheels, instrument panels, knobs, etc.

This process requires less cellulose (0.7 lb. per pound of yarn), than do the other two processes. Cellulose acetate is an electrical insulator where the regenerated cellulose type rayons are not; will not shrink where the other two do; is non-flammable and is not affected by cotton dyes while the others are. The easy re-solution and re-spinability of waste and faulty production is an attractive economical feature of the process. Cellulose acetate electrical insulation can be woven on (replacing cotton-covered wire), or lacquered on the wire. This latter insulation is reported to be tough and pliable.

Independence of cotton linters as the cellulose raw material has been achieved and commercial amounts of acetate from wood pulp are appearing on the market. Patents have been taken out covering the preparation of satisfactory wood pulps for acetylation. Dean Harry F. Lewis, The Institute of Paper Chemistry, during his early spring 1937 visit to the Pacific Northwest, predicted the manufacture of cellulose acetate from wood pulp on a commercial scale within a year.

Looking back at our promise of cheap acetic acid, where is it to come from? The greater part of our synthetic acetic acid comes from acetylene; but the petroleum industry, which already is supplying lacquer solvents and plasticizers, is the most probable source. For years the Standard Oil Co. of New Jersey has been making isopropyl and higher alcohols from otherwise waste refinery gases at its Bayway, N. J., refinery; and recovering large quantities of acetylene as a byproduct in the production of hydrogen from refinery gases at its Baton Rouge, La., refinery. Cracking of suitable petroleum hydrocarbons yields commercially important quantities of ethylene, a strong rival of acetylene as a source of acetic acid and acetone. Both acetone and acetic acid can be synthesized cheaply from isopropyl alcohol. Catalytic oxidation of the ethylene yields ethanol, which can be converted into acetic acid and acetone. A plant in England is reported to be making 20,000,000 lb. of acetic acid per year by this synthesis (*Proc.*, 2d Dearborn Conf., Farm Chemurgic Council, May, 1936; also Brooks, *Chem. & Met.*, Jan., 1937, p. 18). According to Partridge (*Ind. Eng. Chem.*, **23**, 1931, p. 482) if synthetic ethanol costs 16–18c. per gallon, the acetic acid derived would cost 3c. per pound.

Of the major oil companies on the Pacific Coast, Shell Chemical has commercial quantities of acetone on the

market, prepared from refinery gases. The preparation of acetic acid is one step further—give them a market.

Thus the petroleum industry has several alternative sources of acetic acid: (1) Acetylene to acetaldehyde to acetic acid to acetone; (2) isopropyl alcohol to petene to acetic acid and acetone; or (3) ethylene to ethanol to acetic acid. The starting materials, refinery gases, being otherwise waste materials, are recovered as assets not chargeable as cost items against the acetic acid product.

In addition to this source, the early announcement of justifiably cheap rates for large blocks of power from Bonneville Dam is expected to bring swift erection of a calcium carbide plant for a further supply of cheap acetic acid and acetone in the Pacific Northwest.

In this country the cuprammonium process, represented by two companies: American Bemberg Corp. and New Process Rayon, Inc., has held on tenaciously to about 3.5 per cent of the total rayon production. Of these, the latter is the 1935 successor to the Furness Corp., and inheritor of the Furness cuprammonium process. Present interest in these processes centers in Bemberg's ability to spin extremely fine filaments, witness this company's 150 denier, 112 filament yarn, produced by the "stretch" spinning method; and in the recently rumored viscose adaptation of the Furness cuprammonium process by the Industrial Rayon Corp. Referring to the description of the Furness process by Olive (*Chem. & Met.*, June, 1932, p. 326), that process is essentially one of "straight-line" production in a single continuous machine, automatically controlled. From the point of delivery of the spinning solution to the spinnerets, through the washing and drying to the twisting of the finished yarn, all operations are uninterrupted. Chief advantages noted in the article were remarkably low minimum requirements for labor and handling. Claims were advanced for a single 2½ hp. motor to drive every 68 spinning positions and the elimination of the usual refrigeration, air conditioning and special ventilating equipment (except for fume hoods over the mixers). The comparative production costs, before depreciation and not including selling expense, for viscose, cuprammonium and Furness (quoted without comment in that article), being within 10 per cent of the market price of the yarn that year for both viscose and cuprammonium, need verification.

Since, in essentials, the viscose and cuprammonium processes are somewhat similar, the end product of both being a regenerated cellulose, it is logical to apply the Furness modification to the viscose process with suitable alterations. This is exactly what Industrial Rayon is rumored to have done. No details of this adaptation have reached publication; but the company is known to have spent a large amount of money on the development and the process is rumored to be actually in operation. Those not directly connected with the process in some cases seem to entertain strong doubts of its economic aspects, understanding that the installation costs are high.

Regional, or geographical, advantages due to wage scale inequalities are rapidly being wiped out. The codes under the N.R.A. of 1932 gave the first strong leveling impulse; labor unrest and strikes since then have carried it on. Let us set up an example of this leveling process. For the rayon industry, a valid comparison of the total cost of direct labor between the Atlantic and Pacific Coasts is impossible; because, as yet, no rayon plant is operating in the Pacific Northwest. However, in finishing its yarn for the market the rayon industry winds, twists and spools it. Consequently, similar textile operations in the Pacific Northwest's woolen and linen weaving and knitting mills will compare.

The 1932 levels of wages for direct labor in the above operations in the rayon industry (situated in the middle and South Atlantic states) were ascertained by a survey of the U. S. Bureau of Labor Statistics[8] to be $0.342 per hour for men and $0.273 per hour for women for a 40-hour week—the mean being $0.3075 per hour. (This survey became the basis of the N.R.A. code for the textile industry.) By the end of 1936 this mean wage had risen to $0.5375 per hour for a 39-hour week[8] (*Chem. & Met.*, Sept., 1937, Part II, p. 535). The government's figures show that wages per rayon worker in August, 1937, were 19 per cent greater than those in August, 1936, and 25 per cent greater than those in August, 1935 (*Pac. Pulp & Paper Ind.*, Nov., 1937, p. 41).

Over the years wages on the Pacific Coast have been generally higher than those East and South; but for 1936 the average wage for winding, twisting and spooling of wool and linen thread was reported as $0.42⅛ per hour for a 40-hour week.

Further, the U. S. Bureau of Labor Statistics reported the average wage for the first six months of 1937 for rayon workers to be $0.597 per hour for a 39½-hour week.

Thus the up-swing of labor costs in the Middle and South Atlantic rayon industry passed Pacific costs; but can be expected to settle back to parity.

New Fields for Rayon

In conclusion let me call attention to the new and enormously important fields that rayon has invaded within the year just passed. *Textile World* (Sept., 1937, p. 104) reports several interesting developments. Rayon cord of the viscose type is being substituted for cotton in heavy duty and high speed bus and truck tires to produce a markedly superior tire for that vast market. This same strong cord was woven into sail cloth for the famous racing yacht "Ranger," providing an opening wedge to the wide mechanical uses of cloth, such as canvas, duck and sheeting. Finally, typewriter ribbons made of Bemberg cuprammonium rayon are stated to be superior with respect to the sharp, clean impression and longer ink life and durability.

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Chemical Engineering TRENDS in the SOAP INDUSTRY

By OSCAR H. WURSTER

As one of the relatively few chemical engineers who have specialized in the soap, and fat and oil industries during the past thirty years, Oscar H. Wurster has accumulated an enviable experience in this important division of chemical engineering. The earlier half of that time was spent in the operation of plants producing soap, glycerine and fatty acids and in the development of processes in these plants. In 1921, he joined with the late Walter Sanger in organizing the firm of Wurster & Sanger which has been closely identified with many of the modern advances that have taken place in soap making, glycerine purification and the distillation of fatty acids. He is president of this Dayton, Ohio, company.

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THE SOAP INDUSTRY has experienced numerous developments of interest and importance in recent years. In no product is there keener competition for the consuming public's favor. This in itself is a natural incentive to improve the methods of production of standard types of soap, to improve the quality of these products and to develop new processes and products. A further important contributing factor lies in the constantly increasing research and development activities, and in the ability and experience of the men in this work.

In working towards the goal of improved methods and quality, new processes and products, there is considerable overlapping of these aims in results accomplished.

Improved methods of production are reflected in practically all of the older forms of soap products. Soap products in powdered form, formerly made by grinding, are now made in granular or globular forms by spray processes. The use of spray processes has developed distinctly new products, with characteristics different from the older forms which they replace.

In the production of toilet soaps, the continuous and automatic movement and handling of the materials from the kettle to finished soap packed for shipment has advanced to a remarkable degree of perfection. The operators along the line act more as attendants. One outstanding improvement in this chain of operations in toilet soap making has been the extensive replacement of mills by plodders. Until recently the plodder has been used only to compress the milled soap to put it into its final firm form for stamping. Now the plodder is used to perform the functions of mixing, crushing and working formerly performed by mills and to do them better and more economically. Some special designs of plodders have been developed for this purpose, but the standard machines as generally used and with only slight modification are available for even moderate capacity requirements. These machines are placed in series, one machine discharging directly into the next.

Discoloration of the finished soap due to impurities and to oxidation and rancidity caused by the catalystic action of traces of copper and iron has always been a problem. This difficulty has been successfully overcome by attacking the matter from two distinct fronts. Mechanically the problem has been met by the use of soap

kettles and other equipment with the surfaces exposed to the material made of stainless steel or nickel. The chemical solution to the problem has been the development and use of a number of inhibitors which prevent completely rancidity, spotting and discoloration of the finished products. Among the antioxidents or inhibitors referred to in patent and other literature as used for this purpose are diphenylamine, aromatic amines, cyanamide compounds, dicyanadiamide, amino sulphonic acid compounds, aliphatic and aromatic amino sulphonic acid compounds, sodium salt of sulphonilic acid, sodium salt of napthionic acid, aliphatic amino carboxylic acid compounds, sodium salts of aliphatic amino carboxylic acid, para-tertiary-amyl phenol, zinc sulphide, moleic acid, phthalic acid, pyrogallol, pyrocatechol, guaiacol, diaryl amine, hydroquinon and diphenylquanadine.

In addition to lining soap kettles with nickel or stainless steel, a further departure from former practice has been to cover the kettles and keep them closed while operating. Ducts are provided for carrying away the steam when boiling. This has improved the operation, comfort and appearance of the kettle room.

Chemical engineers not directly engaged in the soap industry frequently ask, when visiting a soap plant, why an operation carried out on as large a scale as soap boiling is still a batch process. Needless to say, those engaged in the industry have also asked themselves the same question and have worked on the problems involved. Practically all soap is made at present by boiling fat and alkali in kettles. It is a matter of getting the soap in the desired form and purity from the fats and oils available, of recovering the glycerine and doing both in the most economical manner.

An interesting and successful development of recent years is the rapid saponification process. Fats and oils are mixed with caustic soda and by the addition of an accelerator and the heat of the reaction almost immediate saponification results. This process is continuous, and in large scale commercial operations about two hours are required from raw materials to finished soap. An excellent soap is produced, superior in some respects to soap made by the boiled process because the glycerine is left in the product. The use of this process depends on the value of the glycerine. While operated on a large scale for several years, its use at present is limited to special purposes where the loss of the glycerine is offset by other advantages.

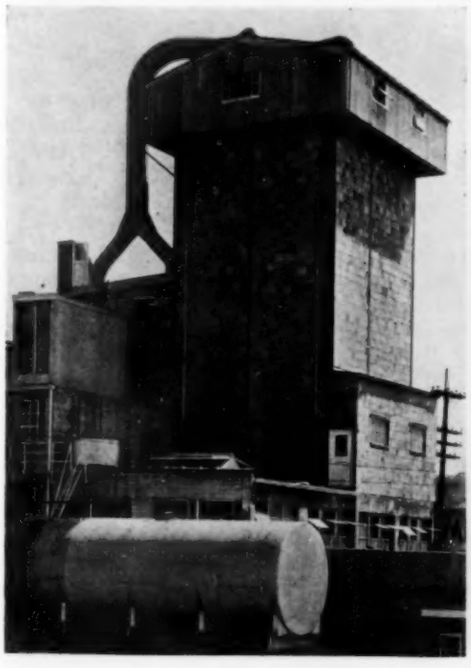
Processes for the continuous saponification of fats and oils with the recovery of glycerine have reached the pilot plant stage. In one process saponification is carried out under high pressure and temperature and the glycerine and moisture are flashed off in a vacuum chamber. The soap is produced in an anhydrous, powdered condition and is then processed to the desired form. Such a continuous soap making and glycerine recovery plant has now been in satisfactory commercial operation for several months.

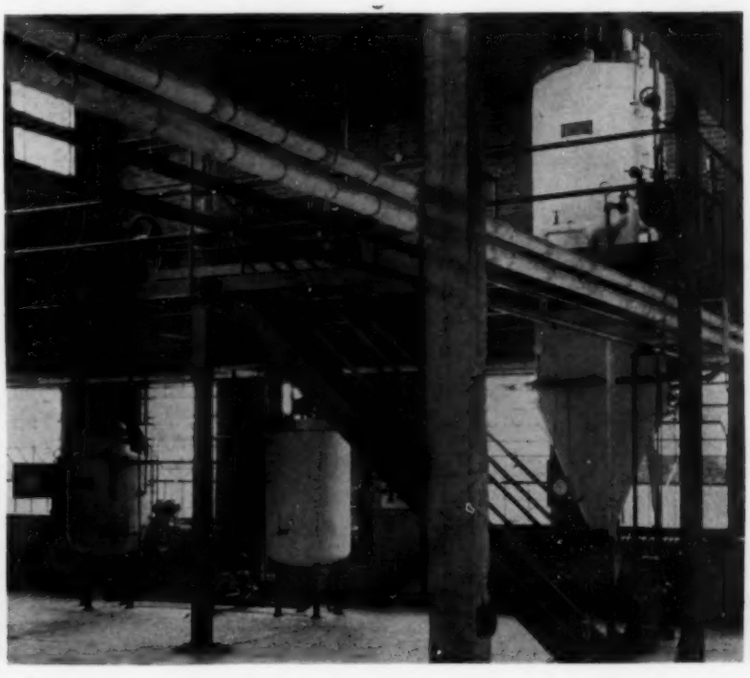
In the soap boiling process there are numerous "changes", and impurities originally in the fats and oils are drawn off with each spent lye. There is, therefore, a purification process taking place simultaneously with the boiling and settling operations. It is not possible to accomplish such purification of the raw materials in the continuous processes which have been developed.

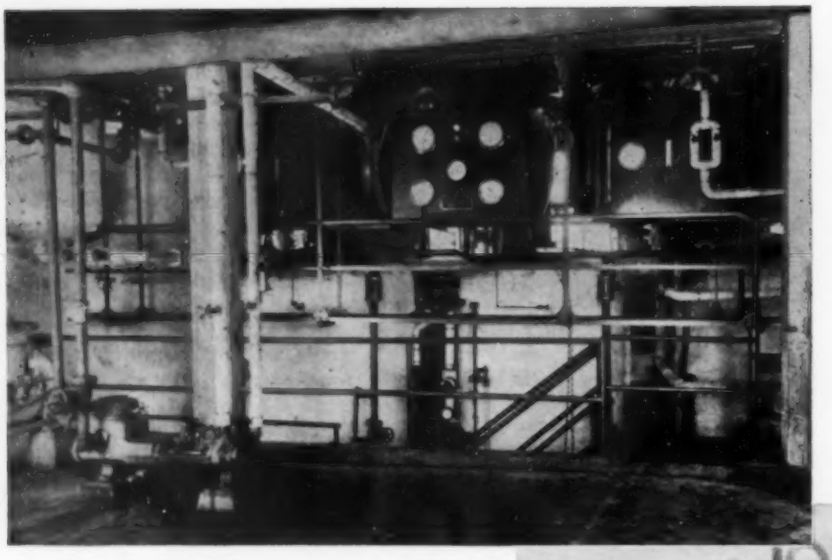
The soap manufacturer has always availed himself of

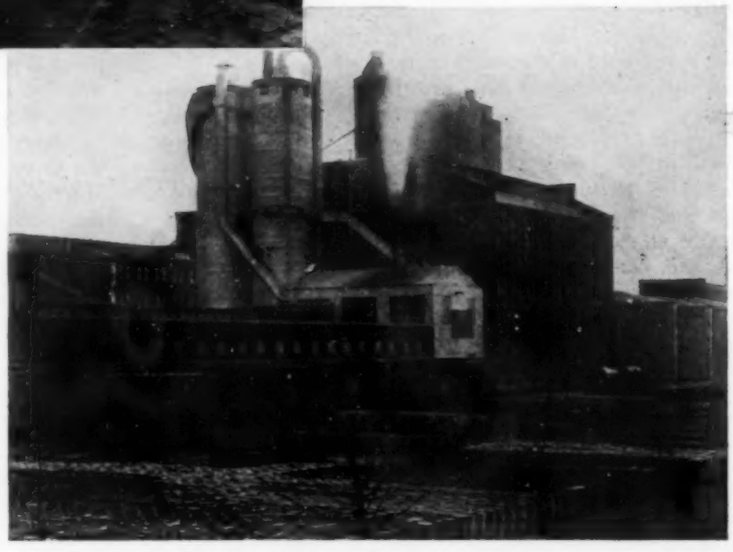
CHEMICAL ENGINEERING *Trends* IN PROCESS INDUSTRIES

Left—Soap powders relatively low in soap and high in soda ash are made in the spray process plant. The process is largely one of crystallization, the excess moisture being taken up by the soda ash as water of crystallization. The product is a uniformally granular powder. Right—The hydrogenation plant is suitable for hardening fish and whale oils for soap making









Above—A continuous glycerine distillation plant where glycerine is distilled to make C. P. and dynamite grades. High vacuum, low operating temperatures and continuous removal of salt result in high yields of glycerine, production of chemically pure glycerine in one distillation and low operating costs. Right—Globular, hollow-bead soaps are sprayed in the towers. In this process heat is used to remove excess moisture introduced with the ingredients. Powdered soaps high in soap content are made

all possible sources of raw materials. Hydrogenation has made hardened fish and whale oils available and their use, formerly restricted to the larger plants, has become more general. Not only are hydrogenated oils more generally available, but hydrogenation plants of moderate capacities have been developed which can be operated economically when a suitable supply of hydrogen is available.

The development of the continuous distillation of fatty acids has brought to the soap maker fatty acids of greatly improved quality in respect to color and odor at lower cost.

The fractional distillation of fatty acids has opened up other opportunities for the soap maker which have already been put into practice. The possibilities in this respect may be outlined briefly. Since soap has been made, fats and oils have been used almost exclusively as found in nature. One exception to this has been the use of "red oil" for certain soaps, notably textile soaps, red oil being the liquid fatty acids pressed from mixed fatty acids in the production of stearic acid. To modify the soaps and to give them the desired qualities and characteristics it was possible to select the fats and oils required from those available, but the possible selection was limited by the natural composition of fats and oils. It is known, however, that some glycerides are better than others for making certain soaps, that is, for soaps used for special purposes, as for example textile soaps, laundry chip soaps or household flake soaps. By the fractional distillation of fatty acids the soap maker can select the fatty acids best suited for the different kinds of soaps and in this respect free himself to some extent from the natural limitations.

Continuous fat splitting is now reported in operation in several plants. The importance of this is not only in the economy of the process but also in the quality of the fatty acids when splitting high grade fats. This development should lead to the increased use of fatty acids for soap making in place of the neutral fats and may affect other soap plant processes. Glycerine recovery is simplified. Starting with crude fatty acids made by splitting high-grade fats or with distilled fatty acids, it may be possible, as a next step, to develop continuous soap making processes more suitable for general use.

Kettle room procedure has been modified to a considerable extent in recent years. When the writer first started working in a soap plant it was the general practice to take off about three pounds of spent lye per pound of fat saponified. This gave spent lyes for the glycerine plant which averaged about 3.5 per cent glycerol. The glycerol content of the spent lyes has been increased gradually until now, by countercurrent working in the kettle room, the spent soap lyes in some plants average as high as 10 per cent to 11 per cent glycerol. At the same time, the spent lyes reach the glycerine plant practically neutral.

The cost of recovering the glycerine has been reduced in this manner and greater attention has been given to other improvements in the processes and equipment for recovering and refining the glycerine.

With spent lyes nearly neutral, it is economical to use hydrochloric acid to complete the neutralization in place of sulphuric acid which was formerly used in most plants. Also, ferric chloride has largely replaced aluminum sulphate as the coagulant. With these reagents, the spent lye treatment for purification prior to evaporation introduces only chlorides, and the recovered salt remains pure sodium chloride. When sulphuric acid and aluminum sulphate are used, the sodium sulphate content of the recovered salt gradually increases until, with a sulphate content of 25 to 30 per cent, its graining property is so far reduced that it must be discarded. This not only requires replacement with fresh salt for salting out the soap in the kettle room but involves the loss of any glycerine remaining in the salt which is discarded.

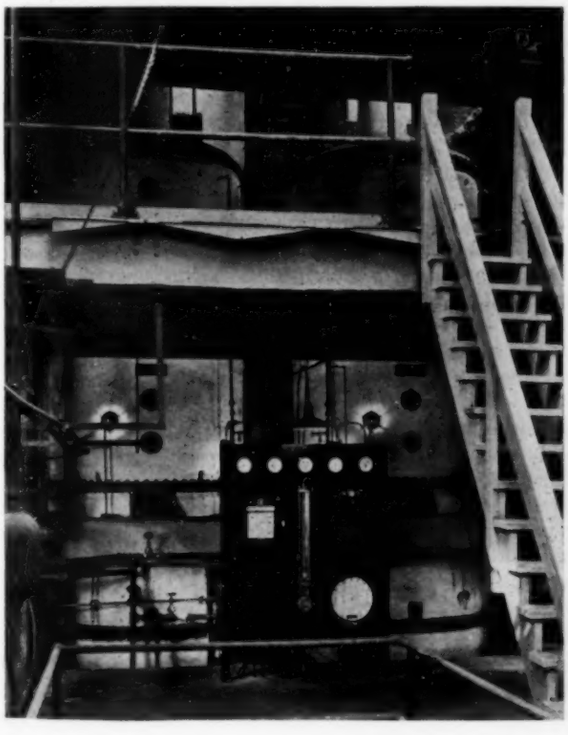
Greater precautions are taken in every way to avoid losses of glycerine in the recovery process. The cost of recovery is the same whether or not the maximum yield is obtained, therefore costs incurred to insure increased yields are quickly returned. Entrainment separators are used to avoid entrainment losses. Indicating and control equipment is provided to insure the proper operation of the evaporators.

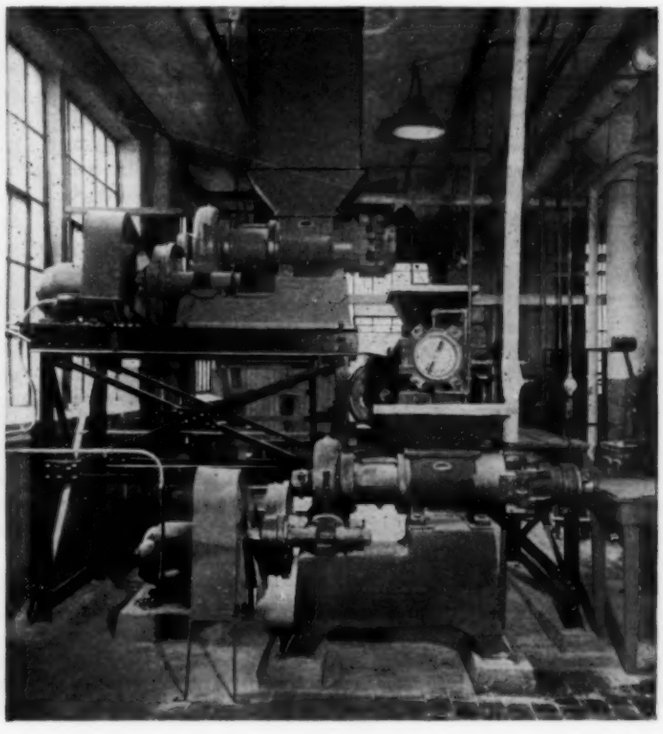
Several glycerine evaporators have been built recently with all castings made of nickel-chromium cast iron. Tests have indicated that this alloy cast iron will corrode less in this service than grey iron castings.

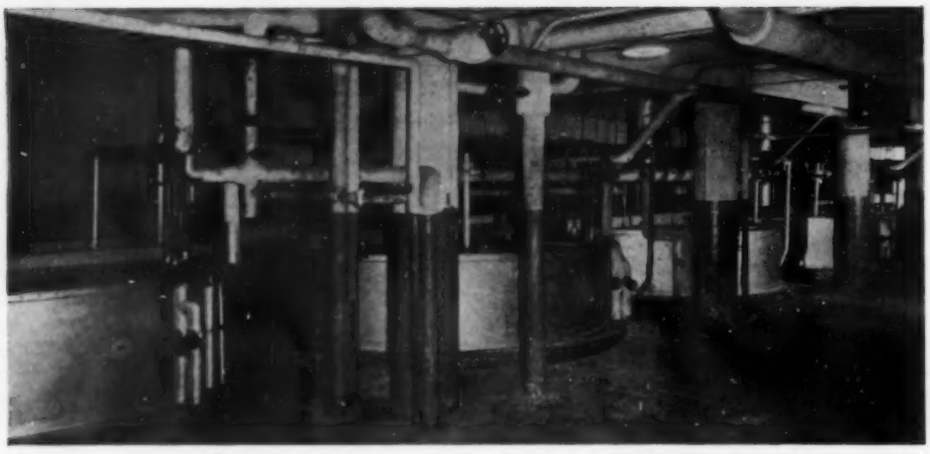
The refining of crude glycerine for the production of chemically pure and dynamite grades is now carried out in continuous distilling equipment. This is made possible by the continuous removal of the salt from the still and subsequent centrifugal separation of the salt and glycerine. Chemically pure glycerine is now made in one distillation from soap lye crude glycerine of average quality. By operating with present-day high vacuum equipment and a correspondingly low still temperature, with a low temperature differential between the heating element and the glycerine, and with the removal of the salt as stated above, exceptionally high yields of finished product are obtained. The operating costs are low due to the low steam and labor requirements.

In discussing developments in the soap industry reference to the new types of detergents, the so-called "soapless detergents," should be included. The sulphated fatty alcohols marketed under various trade names, have found extensive use for some purposes. One of their outstand-

Left—Double effect glycerine evaporators used to concentrate spent soap lyes containing from 3 to 11 per cent glycerol to soap lye crude glycerine containing 80 to 82 per cent glycerol. All castings of the equipment are made of nickel chromium iron. Right—Soap is mixed and fed from the floor above to the first plodder. The three plodders are arranged in series, the soap discharged from one plodder dropping to the next in series. This work was formerly done with granite or steel roll mills







In this modern kettle room the kettles are covered and provided with ducts to carry off the vapors. Kettles, covers and ducts are stainless clad-steel

ing properties is that of lathering freely in hard water without forming a precipitate. The formation of precipitates resulting from the use of soap with hard water must be avoided in some industrial uses, as in the textile industry, and this is therefore a field of usefulness for the higher fatty alcohol sulphates. About the same time that the new detergents were made available, the use of sodium hexametaphosphate as an adjuvant to soap to prevent precipitation in hard water was discovered, so that the use of soap for these conditions is by no means made obsolete.

Trends more marked than ever before which the soap industry no doubt has in common with other chemical industries, are more intensive study and research of the raw materials, processes, equipment and products and more accurate control of all plant operations.

Engineering Symposium Considers Drying and Air Conditioning

MORE THAN 200 chemical engineers, chemists and visitors met at the University of Pennsylvania in Philadelphia on Dec. 27-28 to attend the Fourth Chemical Engineering Symposium sponsored by the Division of Industrial and Engineering Chemistry of the American Chemical Society. The program, calculated to appeal both to the engineer in the process industries and to the teacher of chemical engineering, included some 12 full-length papers, plus a round-table equipment discussion in which nine shorter papers were offered, each by an engineer intimately associated with a particular branch of the dryer industry. A feature which aroused as much interest as the technical sessions was the presentation of a talk by a recognized television expert on the trends in television equipment design and the problems incident to the commercialization of this new form of communication.

Introducing the symposium, E. R. Gilliland of the Massachusetts Institute of Technology presented a paper briefly surveying the fundamentals of drying and air conditioning and reviewing the basic equations dealing with the rate of heat transfer and mass transfer. The mass transfer coefficients were considered in the light of the film and turbulent-core concept as well as on the basis of empirical dimensional equations. Core and film resistances in some circumstances are found to be of the same order of magnitude. The point was made that although a large amount of experimental work has been carried out in heat transfer alone, in the case of mass transfer the experimental data are meager and broad empirical correlations not available.

A type of chart giving equilibrium vapor pressures for a two-component system, one of which is volotile, was described by Albert B. Newman, of Cooper Union. This chart may be applied, for example, to the system calcium chloride: water. On it the relative vapor pressure, which is defined as the actual vapor pressure, divided by the vapor pressure of the pure volatile component at the same temperature, is plotted as ordinate against temperature as abscissa. The chart has a variety of uses. In air conditioning, for example, it can be used for predicting the range of humidities and temperatures of initial air which can be contacted with any solid phase without danger of producing a liquid phase; for predicting the conditions under which the original hydrate can be regenerated; and for predicting the strength of solution in equilibrium with air in any temperature and humidity.

Two papers were presented covering phases of air and gas drying by means of adsorption methods. R. B. Derr, of the Aluminum Co. of America, discussed the type using activated alumina. This material is capable of absorbing almost 100 per cent of the moisture from a gas passed over it, until is has taken up 12 to 14 per cent of its weight of water. Regeneration of the alumina is readily accomplished at relatively low temperature. Large commercial units capable of removing up to 15,000 lb. of water from the atmosphere per day are now in operation. In answer to a question, Mr. Derr stated that there is no evidence of the deterioration of activated alumina in use, even over long periods of time.

Dealing with one type of solution cycle for the dehydration of air, F. R. Bichowsky, of the consulting engineering division of Dow Chemical Co., discussed the use of lithium chloride solutions. The thermodynamic properties of such solutions in the entire range of con-

centration, and for temperatures from −20 to 160 deg. C. have been determined. Passing over this fact hastily, Dr. Bichowsky devoted most of his time to the industrial applications of this method, with particular reference to a closed-circuit, low-temperature dryer for organic materials such as glue and gelatin. Moisture is removed from the material by air drying, then removed from the air by contacting with lithium chloride solution. In actual practice, operating costs of low-temperature drying by this system have been found to be as low as 4 per cent of the operating costs of drying using refrigerated air.

A. W. Hixson and G. E. White, of Columbia University and the College of the City of New York, respectively, described in considerable detail the construction and application of a new apparatus for the accurate determination of dew points. This apparatus measures photoelectrically the quantity of light reflected from a metal mirror on which the dew is deposited.

The question of evaporation of water into quiet air was considered by B. F. Sharpley, of the Pelton Water Wheel Co., and L. M. K. Boelter, of the University of California. An apparatus for experimental determination, designed to minimize errors, was described and equations presented by which the unit evaporation rate may be calculated in terms of vapor density.

Experimental results on the rate of evaporation from a free water surface to a transverse air stream were reported by M. C. Molstad of Yale University. This experimenter found that the evaporation rates are much lower than those calculated using the equation proposed by Carrier, but are somewhat higher than those found when the air flow is parallel to the surface. A comparison of the rate of evaporation of moisture from a wet material and from a free water surface was presented by A. E. Stacey, Jr., Buensod-Stacey Air Conditioning, Inc.

Experimenting for Dryer Design

The remaining papers of the symposium dealt exclusively with drying. A paper by C. B. Shepherd, C. Hadlock and R. C. Brewer, all of E. I. du Pont de Nemours & Co., reported on drying experiments conducted in connection with the design of plant drying equipment for non-hygroscopic materials in trays. With material such as sand, most of the drying occurs during the so-called constant-rate period. This rate may be expressed either in terms of the heat transfer coefficient or the mass transfer coefficient, both of which vary with the 0.8 power of the air velocity over most of the velocity range covered. Under certain circumstances the experimental data, it is shown, can be used for predicting results with similar materials.

A comparison of air and vacuum drying of commercial prussian blue pigment was made by R. C. Ernst, D. B. Ardern and F. M. Tiller of the University of Louisville. Correlating the results obtained with the two types of drying, the authors discussed the probable drying mechanism. A second paper presented by Messrs. Ernst and Tiller, with J. W. Ridgway, also of the University of Louisville, gave additional information on the drying of an inert solid under vacuum.

Both the mechanism of spray drying and its economic aspects were considered by B. B. Fogler and R. V. Kleinschmidt of Arthur D. Little, Inc. The feature of this presentation was an ultra-slow motion picture, which gave an excellent idea of the production of droplets by a spray nozzle. The authors discussed the advantages of spray drying, mentioning form of product and the use of low temperature. As a disadvantage, they pointed to the relatively low thermal efficiency of the average spray dryer and showed why heat recovery is difficult.

Drying Equipment Round Table

As a closing feature of the meeting, a series of nine short papers on drying equipment was presented. The general subject of rotary dryers was discussed by B. A. Smith of the C. O. Bartlett & Snow Co. Typical thermal efficiencies for each general type were presented. J. L. Erisman of the Link-Belt Co. described the rotary louvre dryer, a rotary cylindrical type in which the drying gas is forced through the material. The author mentioned a considerable number of applications, giving performance data in each case. A discussion of the steam tube rotary dryer was presented by C. E. Bill of the Louisville Drying Machinery Co. This author made the point that this type of dryer is a constant-temperature, variable-feed machine, as distinguished from other types of internally heated rotary dryer. The entering feed is heated in an atmosphere of high humidity, thus tending to prevent case hardening.

The principles of the several types of Turbo dryer were briefly described by Arnold Weisselberg, consultant for the Buell Engineering Co., with particular reference to the vertical Turbo. A motion picture showed a large starch dryer in actual operation. A new cylindrical type conveyor Turbo, not yet used in the United States, was described briefly. Mr. Weisselberg emphasized the tremendous holding capacity of such a dryer. Four phases of the spray drying process were discussed by W. S. Bowen of Bowen Research Corp. These included: producing the drying medium; atomizing the material to be dried; contacting material and drying medium; and removing the dry solids. Two types of filter dryer manufactured by Oliver United Filters, Inc., were described by D. F. Irvin. One type is a top-feed rotary crystal filter encased so that heated air can be drawn through the cake while the other, the D. L. O. dryer, a modification of the Dwight-Lloyd sintering machine, consists of a conveyor bed of pallets on which material to be dried is conducted through a casing while heated air flows downward through the bed.

In describing the Proctor & Schwartz Aeroform dryer, A. O. Hurxthal stressed the fact that two distinct drying stages are employed with this equipment. The pre-drying stage is accomplished on a finned drum which preforms and partially dries the material in the form of small sticks, while the final stage is accomplished in a conveyor dryer. For types of material such as lithopone which can be handled in this fashion, this method is said to result in much higher efficiency and shorter drying time. Another type of drum drying was described by D. J. Van Marle of the Buffalo Foundry & Machine Co. Referring to both single and double drum dryers, the author discussed various methods of feeding and the mechanism of heat transfer. He showed that the resistance of the metal wall is often the controlling factor in heat transfer. A final paper, describing vacuum dryers with agitators, was presented by L. H. Bailey of the F. J. Stokes Machine Co. In such dryers material is agitated within a heated cylinder under vacuum. This method has recently been found satisfactory for materials which foam badly during drying.

Trends in Processes, Raw Materials and Uses for Sulphuric Acid

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Outstanding as an authority on chemical economics, Professor Kreps is the author of the monograph, "Economics of the Sulphuric Acid Industry," which was published on January 5 by the Stanford University Press. By permission of the author and publisher we are privileged to present here an article condensed and adapted from Chapter XII of this book. The current monograph is planned to be the first of a series which will give similar treatment to other important industrial chemicals.—Editor.

EXAMINATION of the uses of sulphuric acid makes it clear that in ordinary years the most important outlets, in order of volume of consumption, are: fertilizers, which usually take between 25 and 35 per cent of the whole supply; petroleum refining, taking about 30 per cent; chemicals, consuming about 10 per cent; the byproduct coke industry, consuming another 10 per cent; the cleaning (pickling) of iron and steel preparatory to galvanizing taking somewhat less than 10 per cent; other metallurgical processes taking roughly 8 per cent; and a variety of other uses including paints, pigments, rayon, and textile processing, consuming the remainder, that is, from 10 to 15 per cent.

Chemically, sulphuric acid serves four main purposes: as a strong, cheap acid; as a dehydrating agent in organic reactions; for sulphonations; and as an oxidizing agent. Even to enumerate only the principal applications of the acid is a long, detailed, tiresome, but instructive task.

Sulphuric acid of 50 deg. Bé. up to 60 deg. Bé. strengths is used in making salt cake, hydrochloric acid, soap, superphosphates and other artificial manures, and sulphurous, nitric, phosphoric, hydrofluoric, boric, carbonic, chromic, oxalic, tartaric, citric, acetic, and stearic acids; in preparing iodine, bromine, the sulphates of potassium, ammonium, barium (blanc fixe), and calcium (pearl hardening); the sulphates of magnesium, aluminum, iron, zinc, copper, and mercury (as an intermediate stage for calomel and corrosive sublimate); in the metallurgy of copper, cobalt, nickel, platinum, silver; for cleaning sheet iron to be tinned or galvanized, copper, silver, etc.; for manufacturing potassium dichromate; for galvanic cells and storage batteries; for manufacturing ordinary ether and the composite ethers; for parchment paper; for the purification of many mineral oils and sometimes coal gas; for manufacturing starch, syrup, and sugar; for neutralizing the alkaline reactions of fermenting liquors, such as molasses; for preparing tallow previous to melting it; for recovering the fatty acids from soap suds; for destroying vegetable fibers in mixed fibers; generally, in dyeing, bleaching, mordanting, calico printing, and tanning; in medicine against lead poisoning, and in many other cases. Sulphuric acid of 66 deg. Bé. strength is used for the manufacture of fatty acids by distillation; for purifying benzene, petroleum, paraffin oil, and other mineral oils; for refining gold and silver, desilvering copper; for making organic sulphonic acids; in the manufacture of coal-tar dyes, pyroxylin plastics, explosives, rayon, celluloid and for making nitric-acid compounds and nitro-ethers in general. Oleum is required for the manufacture of many organo-sulphonic acids used in the manufacture of certain dyes, such as synthetic indigo, eosin and alizarin; for making shoe blacking; also for increasing the ordinary strength of sulphuric acid to higher concentrations. These are some of the main uses of the various grades of sulphuric acid.

The outstanding feature of marketing sulphuric acid is the fact that four-fifths of it is consumed by the chemical process industries. Most of it is sold direct, the manufacturer using his own tank cars and trucks, making deliveries in car-load lots direct from the plant and in less than car-load lots from spot stocks carried in his own warehouses. These stocks, however, are never very large, sulphuric acid beng too dangerous and explosive to store in quantity. Even in the highly seasonal fertilizer industry sulphuric acid is made when and usually where ready to be consumed. Only a small amount is sold through brokers, selling agents, or other distributors. Still less is sold through retail outlets. In 1929, according to the Census of Distribution published by the U. S. Bureau of the Census, of a total of 715 million dollars worth of chemicals, only 1.7 per cent was sold to retailers and 21.2 per cent to wholesalers, while 15.4 per cent was disposed of to branch wholesalers owned by the manufacturers and 61.7 per cent was sold direct to industrial consumers.

Consumption in Various Industries

Before the World War more than one-half of the total sulphuric acid produced in the United States was consumed in the manufacture of fertilizers. The development of other uses caused this percentage to be cut in two during and after the World War, though in absolute amounts in prosperous times the tonnage has fluctuated in the neighborhood of 2,000,000 tons. The accompanying tabulation gives the figures in detail, showing clearly that except for the year 1918, when abnormal quantities of sulphuric acid were taken by the explosives industry,

and the depression year 1932, the fertilizer industry has always been the largest consumer.

The next largest consumer except for the year 1918 has always been the petroleum industry. During the depression it held up considerably better than the fertilizer industry with the result that in the year 1932, despite a declining trend in total consumption, it was the largest outlet of all. In the twenties it took roughly a fifth of the total acid produced, but in the last five years a series of improvements in refining technology has reduced its requirements of acid by more than 50 per cent per barrel of distillate.

The next largest consumer, the "chemicals-not-elsewhere-classified" industry, normally takes from an eighth to a sixth of the total acid produced. During the depression its consumption of sulphuric acid sank only a sixth below 1929 levels whereas that of fertilizers and of the iron and steel industries sank two-thirds and that of the explosives, paint and pigment and miscellaneous industries about one-third.

Two other facts should be noticed, first, the substantial readjustment forced upon the sulphuric acid industry by the World War, especially the shift of usage from fertilizers to explosives; chemicals (i.e., dye-stuffs and coal-tar products); and iron and steel pickling (i.e., the canning industry). Second, note the rapid rise of consumption in the rayon industry without substantial setback even during the depression.

Outlook for Sulphuric Acid

A characteristic feature of chemical industries is that forecasts are extraordinarily difficult to make. No matter how old and seemingly well established the industry a host of technical and economic possibilities and probabilities beset the demand and supply of any one product. To evaluate these possibilities and probabilities is a difficult task and to predict which one or two may become all-important in the next five years is almost impossible.

Sulphuric acid is no exception. On every hand are fluctuations, shifts of relative advantages in the processes used, variations in sources of supply and types of raw material, changes in the economic situation of the industries producing it, and potential competition in the various markets. To aggregate, integrate and evaluate all these forces of demand and supply and make even a brief statement of outlook that is certain to be true is impossible. But it is likewise unnecessary. All that is required is a summary of factors as of the present time with a mention of potentialities that may become significant realities.

Beginning with the factors of sulphuric acid supply, let us recall that at the present time the contact process is rapidly gaining competitive success over the long-established chamber process. Now vanadium catalysts have enabled contact plants to dispense with burner gas purification systems (with brimstone gas.—Ed.) In addition the X-ray treatment of catalysts, experimentation with silica gel as a carrier of platinum, and other developments may readily increase the average over-all conversion efficiency of sulphur into sulphuric acid under normal plant loading to a higher level than the 95 per cent figure now prevalent which, of course, will mean cheaper sulphuric acid of concentrated strengths.

Whether the chamber process will be able to retain its hold on the production of 50 deg. Bé. sulphuric acid will depend on whether the improvements in it keep ahead of new developments in the contact process. In Europe tower systems, the Schmiedel box and Gaillard turbo-dispenser systems for intensifying operations, and especially plants of Mills-Packard design, have so reduced the amount of space (and hence investment) required per pound of sulphur burned daily that the contact process has gained only a fraction of the headway that it has won in the United States. Improvements such as these may enable the chamber process to survive. At the present time, however, the new plants being built are practically all of them contact-acid plants, the construction of an old style chamber plant by a fertilizer producer in the East in 1936 causing "considerable surprise among acid men," according to *Chem. & Met.* (Feb., 1937, p. 78).

When the outlook in the competition of raw materials is considered, several possibilities of promise present themselves. First and foremost, of course, is the possibility of increasing the production of sulphuric acid from the waste gases of sulphide smelters. A noted technician, William M. Grosvenor, states in Rogers' "Manual of Industrial Chemistry," 5th ed., 1931, p. 117, "Careful study of the question for years leads the writer to believe that, in practically all cases, it is feasible to recover such fumes, that marketable products can be profitably produced in any locality where large smelters now operate, that the value thus produced will in many instances exceed that of the metal produced, and that no other phase of the sulphuric acid industry is so important." In an earlier edition this same authority pointed out that at that time, 1917, a single company at two plants was wasting enough sulphur yearly to equal the pre-War production of sulphuric acid in the United States (3d ed., 1920, p. 129). Yet it defended damage suits and injunctions in preference to developing the outlets for the chemicals it might be able to produce. A government publication (U. S. Tariff Board, "Chemicals, Oils and Paint," glossary on Schedule

Estimated Consumption of Sulphuric Acid by Industries, 1900-36

(Quantities expressed in thousands of short tons of 50 deg. Bé. sulphuric acid. Unless otherwise indicated estimates are from *Chem. & Met.* Annual Review Numbers.)

	Total Sulphuric Acid	Fertilisers	Petroleum Refining	Chemicals	Coal Products	Iron and Steel	Other Metallurgical	Paints and Pigments	Explosives	Rayon and Cellulose Film	Miscel. incl. Textiles
1900	1,548[1]	803	182	265	14	125	(a)	(a)	13	(a)	145
1909–11	3,250[2]	2,400	300	200	(a)	200	(a)	(a)	150	(a)	(a)
1918	7,510	2,130	671	740	(a)	700	292	204	2,700	(a)	75
1923	6,600	2,070	1,200	1,000		700	500	198	200	(a)	732
1924	6,180	1,800	1,300	1,000		600	600	200	180	(a)	500
1925	6,853	1,975	1,450	1,100		725	700	200	185	(a)	518
1926	7,168	2,050	1,325	750	742	740	725	200	190	(a)	437
1927	6,935	1,925	1,350	725	732	685	700	210	183	(a)	425
1928	7,225	2,300	1,350	745	740	670	570	205	170	105	370
1929	8,338	2,418	1,570	890	935	800	675	225	195	150	480
1930	7,625	2,350	1,485	820	800	660	560	200	177	145	428
1931	5,904	1,455	1,348	760	570	480	410	180	175	183	343
1932	4,410	780	1,240	674	375	270	310	160	120	176	305
1933	5,148	1,200	1,140	725	468	390	360	170	140	242	303
1934	6,166	1,650	1,100	910	500	475	400	330	180	256	365
1935	6,725	1,730	980	940	625	630	520	400	175	309	416
1936	7,620	1,970	1,100	985	770	700	600	450	220	337	488

(a) No data.
[1] All 1900 data from Bulletin 92, U. S. Bureau of Census (1908), Table 17, p. 23.
[2] Estimates of U. Wedge, *Am. Fert.*, Oct. 19, 1912, pp. 39–42; chemicals figure includes gold and silver metallurgy; iron and steel figure includes coke; explosives figure includes nitrocellulose, nitroglycerine and celluloid.

A, 1912, p. 20) similarly reported in 1912 that "one smelter in the West discharges daily into the air, 1,000 tons of sulphur in the form of sulphur dioxide, or practically one-half in weight of our total consumption of sulphur for sulphuric acid and other purposes."

On the other hand, counter-arguments are advanced (Cameron, *Chem. & Met.*, Mar., 1927, p. 169) that stack gases from smelter plants contain too low a percentage of sulphur dioxide to permit the production of cheap acid and that "to produce a concentration suitable for acid manufacture would seriously reduce the metal production as well as shorten the campaign of the roasters." Moreover, no market seems available unless the growth of intensive agriculture in the intermountain area creates so large a demand for fertilizers that the prosphate deposits in southwestern Idaho, northeastern Utah and southwestern Wyoming can be developed.

A second byproduct source of sulphur that is regarded as having considerable potentiality is the oil industry. It has, of course, recovered sludge acid in increasing amounts in recent years, practically every refinery of any size having a sludge conversion plant. Furthermore, it has been suggested that future widespread adoption of petroleum hydrogenation would make available for recovery large quantities of hydrogen sulphide gas. In 1936 a new sodium phenolate purification plant was put into operation at El Segundo, California, which makes sulphuric acid out of the hydrogen sulphide in the refinery gases produced by cracking. According to *Chem. & Met.* (Feb. 1937, p. 79) similar plants for the same purpose were contracted for at Philadelphia and Wayne, W. Va. Now if all the sulphur is recovered that is found in the petroleum consumed in the United States, "based on petroleum consumption at the 1929 rate, 173,000,000 short tons, and assuming an average content of 0.5 per cent of sulphur, there would become available from this source approximately 865,000 tons of sulphur, equivalent to 4,200,000 tons of 50 deg. Bé. acid or more than half the entire 1930 sulphuric acid production from all sources." (*Chem. & Met.*, Jan., 1931, p. 37). On the other hand, it is contended (Bacon, *Chem. & Met.*, Oct., 1931) that the process of eliminating sulphur from petroleum by hydrogenation, since it requires large capital expenditure, will not come into general use until the "supply of medium-boiling-point oils, such as gas oils becomes depleted. For several years at least hydrogenation will only be an axiliary to existing processes," used as conditions demand conversion into high-grade gasoline and lubricants of heavy or very asphaltic oils.

Another byproduct source of sulphur for sulphuric acid is coal whether at the mines or at byproduct coke ovens, gas plants, power plants, or lignite carbonization plants. Considerable amounts of sulphuric acid are already being made from coal brasses or marcasite, which while usually picked out by hand are now being obtained in Kansas by an improved metallurgical concentration process in the form of pyrites satisfactory to a contact plant operator in an adjoining state. Flue gas purification processes have been worked experimentally to utilize even the sulphur that goes to waste in the stack gases of factories and power plants and in some cases legislation has been considered thus to mitigate the "smoke evil." In Europe and especially in England the spent iron oxide used to absorb the sulphur-bearing impurities in ordinary illuminating gas made from coal is an important source of sulphur, having constituted in the United Kingdom in 1927 nearly a fourth of the total supply.*

In the United States the utilization of such ferrous sulphate waste has not yet been undertaken on a considerable scale although in recent years a plant has been built in the Middle West using waste ferrous sulphate (from titanium pigment manufacture) to produce over 100 tons per day of monohydrate (*Chem. & Met.*, Jan., 1935, p. 46), and another of equal size has been constructed in the East. If the process proves equally applicable to the ferrous sulphate liquors obtained in pickling iron and steel, the steel industry like the petroleum and explosive industries will use increasing quantities of its own reclaimed acid and less of the product of sulphuric acid producers.

There is one other development in the competition between raw materials that requires brief mention, not because it exists in this country but because of its increasing growth abroad. That is the use of calcium sulphate (gypsum) as a raw material for sulphuric acid. Now gypsum is to be found almost everywhere, being especially abundant in certain strata of limestone. Its use was started in Germany during the World War when she was cut off from her normal requirements of pyrites. Among the many processes in use, the one at the Bayer plant in Leverkusen is said to be particularly successful. It consists in heating gypsum, clay and coal with additions of sand and slag. The resultant sulphur dioxide gases are then purified and turned into sulphuric acid in the usual way. The plant at Leverkusen is reported (U. S. Bureau of Mines, "Mineral Resources of U. S., 1929," part 2, p. 184) to have a yearly capacity of 40,000 to 50,000 tons of sulphuric acid. France is likewise installing plants utilizing gypsum, and similar developments seem to be in the offing in other countries outside the United States.

Substitutes for Sulphuric Acid

Let us turn now to a consideration of substitutes for sulphuric acid, or inter-commodity competition in the narrow sense. Developments here have been particularly numerous, consisting mainly of finding other ways to make the chemical products formerly or usually requiring sulphuric acid.

Foremost in potentiality among such processes tending to replace sulphuric acid would be the extensive use of any of the three variations of the Dorr-Liljenroth process for phosphate fertilizer manufacture. In one of its forms the process would eliminate sulphuric acid entirely. Phosphate rock is put into an electric furnace and yellow phosphorus produced. The phosphorus is then blown in vapor form, together with steam, over a catalyst at about 1,000 deg.C. Phosphoric acid and hydrogen are formed. The hydrogen is used to manufacture synthetic ammonia, say by the Haber-Bosch process. The ammonia is combined with the phosphoric acid to form the concentrated fertilizer ammonium phosphate. The Badische Anilin u. Soda Fabrik already makes such fertilizers, called Diammonphos, in substantial quantities, having remodelled a cyanamide plant with a nitrogen capacity of 30,000 tons a year for that purpose. The phosphoric acid may be united with other compounds of nitrogen, potassium, or any desired ingredient. When, for example, phosphoric acid is used to fix ammonia, it supplements an

* *The Times Imperial and Foreign Trade and Engineering Supplement*, International Chemical and Allied Industries Number, London, Nov. 26, 1927, Vol. XXI, p. 6. In that year the United Kingdom derived 24 per cent of its sulphur from spent oxide, 23 per cent from brimstone, 46.3 per cent from pyrites and 6.7 per cent from zinc concentrates.

inert carrier, the sulphate, with one that has considerable fertilizer value, thus making a concentrated fertilizer and contributing to a substantial lowering of freight costs per unit of fertilizer content.

The primary limitation at the present time seems to be that of changing the fertilizer-using habits of the farmer, who is used to and continues to demand superphosphates, especially the ammoniated superphosphates. Concentrated fertilizers require considerably different and more careful application. Another limitation is the expense of utilizing the electric furnace method of producing phosphorus, unless cheap power can be found, either seasonal or by-product, as for example in the Tennessee Valley. Moreover, the new methods of producing fertilizers require heavy capital investment, something which the existing fertilizer concerns are reluctant, if not unable, to undertake, particularly when they must also scrap existing plant. At the present time, therefore, the wet process, that utilizing sulphuric acid, is still supreme for the making of phosphoric acid of fertilizer grade and strength, though in making phosphoric acid for food and other purposes the thermal processes suffer little or no competition from the wet method. But proponents of both the electric- and blast-furnace processes are pushing costs constantly lower and it is not inconceivable that one system or the other may eventually displace the wet process entirely, especially where strong phosphoric acid is needed.

Another Gypsum Threat?

Another development of importance to the fertilizer industry is that by which gypsum, ammonia, and carbon dioxide are used on the chemical principle of double decomposition to produce ammonium sulphate. Large quantities of gypsum or anhydrite are thus utilized in Germany and in the United Kingdom, the resultant ammonium sulphate frequently being further treated with chili saltpeter or sodium nitrate to produce ammonium nitrate. Again the use of sulphuric acid is eliminated.

In the petroleum industry mention has already been made of processes whereby the sulphur found in many oils may become a raw material for sulphuric acid. But recent improvements in processes not only have reduced but apparently will continue to reduce the amount of sulphuric acid required. Traditionally the sulphur content of gasoline is supposed to be not over one-tenth of one per cent, the treatment of the oil deemed necessary costing the industry an estimated $50,000,000 per year (*Chem. & Met.*, Jan., 1931, p. 36) in loss of product, reduction in anti-knock properties and cost of sulphuric acid used. Recent research has not only established the fact that modern motors can utilize without damage gasoline of considerably higher sulphur content but has devised methods of operation whereby the use of sulphuric acid is eliminated entirely, for example, by treating gasoline in the vapor phase with clay or by treating it with zinc chloride, or by using solvent extraction methods for making lubricating oil, or by adding gum and color inhibitors. Moreover, when the sulphur content of the oil is reduced by the process of hydrogenation (and the resultant hydrogen sulphide made into sulphuric acid), the amount of sulphuric acid consumed is reduced to that for the removal of gum-forming constituents.

The use of sulphuric acid to make other acids is also beset with competition. The greater part of the nitric acid made in the United States is produced by the oxidation of ammonia, rather than by the aid of sulphuric acid, even in the sulphuric acid plants themselves. But nitric acid obtained in this way is already produced so cheaply as to be used in acidulating phosphate rock where it adds valuable nitrogen content in addition to acting as a carrier. The major factor in favor of sulphuric acid here continues to be consumer inertia plus the difficulty and expense of shipping nitric acid to the small superphosphate plants scattered over the South. If farmers were educated to use concentrated fertilizers, large plants making their own nitric acid and phosphoric acid might be established and the use of sulphuric acid in fertilizer manufacture considerably reduced.

Chemical synthesis has dealt reverses to the sulphuric acid industry in other ways. Formic and acetic acids, alcohols, and various other organic compounds are being synthesized by catalytic processes. Even hydrochloric acid is being produced in appreciable quantities by the direct union of chlorine and hydrogen, the former being a byproduct in the electrolytic caustic alkali industry. Thus the contention that sulphuric acid consumption is an index of chemical and industrial progress may be said in some respects to be true to the extent that increases in progress are measured by decreases in the consumption of sulphuric acid. The trend of present chemical research is to find methods of chemical manufacture making sulphuric acid unnecessary. Catalysis, synthesis, high pressures, high temperatures—such are the tools of modern chemical transformations.

Among minor developments mention should be made of the fact that blue vitriol and green vitriol which used to require small amounts of sulphuric acid for their manufacture, are now byproducts of copper refining and iron pickling. Similarly salt cake, which used to be made by the action of sulphuric acid on salt, is now produced in appreciable quantities, especially in Germany, by the action of salt on waste magnesium sulphate. Moreover, in the pickling of iron and steel, increasing use has been made in recent years of inhibitors and electrochemical methods which require little acid.

In the future, therefore, sulphuric acid will probably play a much smaller role in bringing about the chemical transformations of industrial processes than it has in the past. Prior to 1880 the sulphuric acid industry together with the Leblanc alkali industry virtually made up the entire chemical industry. Today in the United States its place has come to be a relatively small one. In 1929, for example, total sales aggregated $45,573,345. While by far the most important of the scores of acids listed, it constituted less than half of their aggregate value which was $98,619,871. But the acids constituted but one of nine groups of products listed under "chemicals-not-elsewhere-classified" whose aggregate production was reported in 1929 as worth $738,048,386 or more than 16 times that of the sulphuric acid sold. But "chemicals-not-elsewhere-classified" constituted a relatively minor part of Group VI listed in the Census of Manufactures and called "Chemicals and Allied Products." These industries in 1929 employed 279,198 workers in 8,224 establishments and put out products valued at $3,702,672,063, a figure more than 80 times the value of the sulphuric acid sold. Truly sulphuric acid in modern times is only one among many chemicals. But historically the sulphuric acid industry, as we have seen, was the primary agent through which was effected that chemical transformation of industrial processes and industrial economics known as the chemical phase of the Industrial Revolution.

What Constitutes Contributory Infringement?

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BECAUSE there are so many chances for chemical manufacturers and equpiment makers to become involved in contributroy infringement, rules governing this phase of the patent law are important in the chemical industry. Contributory infringement consists of doing any of the following things: (1) Knowingly to furnish a part which is to be assembled into a machine which infringes a patented machine, or which is to be used in practicing a patented process; (2) knowingly to furnish raw material to be used in an infringing process, or to make an infringing product; (3) to buy an infringing machine, part, or material, even though it is to be used in making a non-infringing product or process.

Avoiding Dangerous Mistakes

There have been some conflicting decisions covering these broad rules and in one case the Supreme Court of the United States reversed its own ruling, sensing that its first decision, which had seemed just, in practice resulted in grave injustice and hardship. However the cases cited in this article should be helpful in guiding manufacturers away from dangerous mistakes.

While it has been repeatedly held that to supply a part of an infringing machine, knowing that it is to be so used, is contributory infringement, there are exceptions to the rule. For example, a company sold an electric motor to a Canadian manufacturer for use in a machine that was patented in the United States but not in Canada. This was held not to be contributory infringement.

In this case the court also laid down another rule. Although the motor was the essence of the invention, the inventor had neglected to claim it as a separate device, claiming it only as a part of his combination claim. The court held that to make or sell one element of a combination claim is not infringement of a patent covering merely the combination and not the separate elements. Obviously, the same rules would apply to any equipment used in a chemical process as well as to the motor in this case.

One inventor secured a patent on a process, but was unable to patent the equipment for practicing the process. But, a manufacturer who knowingly supplied the unpatented equipment to a concern which intended to practice the patented process, without the permission of the patentee, was held to be a contributory infringer. The theory of the law is that to do what this equipment manufacturer did, amounts to deliberately cooperating with an infringer and that it constitutes, in effect, becoming a partner with him in committing the wrong. It is the intent, or absence of it, that governs.

The safest thing, of course, is to determine whether the equipment is to be used for practicing an infringing process or to be used in an infringing machine, and to refuse to furnish the equipment if it is to be so used. Yet, the courts have said that the seller is not chargeable with the duty of ascertaining whether or not the equipment, or raw materials, are intended for use in infringing any patents.

The machinery manufacturer who provides specially built machinery, which is used in infringing equipment, or to practice an infringing process, will, as a rule, have a hard time proving to the court that he was innocent of intent to cooperate in infringement. But if the machine is part of his regular line and can be used for many other purposes, it is up to the plaintiff to prove intent, which is not always easy.

Sale of Raw Materials

Here are two cases having to do with the sale of raw materials. In one a chemical manufacturer sold one of the ingredients of baking powder to a manufacturer of a powder which infringed a patent. Since he made the sale knowing how the ingredient was to be used, he was held to be a contributory infringer.

On the other hand is the case of a concern which was in the business of selling soybean flour, a provable staple article of commerce, which has many uses, such as for food, as a constituent of tree sprays and in making glue.

The company was sued for contributory infringement on the ground that it furnished soybean flour, an essential ingredient of this type of patented glue, to a manufacturer who was, allegedly, infringing the patent. Because the flour was capable of many other uses, it was necessary for the plaintiff to show, affirmatively, that there was, on the part of the supplier, intent for the flour to be used in an infringing way. Careful consideration

of the evidence resulted in finding that the supplier did not know that there was a patent covering the manufacture of glue from soybean flour, that he sold to the gluemaker as he would to any other customer, that he had no interest in the buyer's business or products, that he never made any suggestions to the buyer regarding his products or method of manufacturing them, and that he had no knowledge or intent that the flour was to be used for an infringing purpose.

To avoid trouble as a contributory infringer it is necessary to be cautious in buying machines and materials, for the user is open to judgment as well as the seller. Here is a case in point, which while it is not taken from the chemical industry, is typical of what can happen in the industry.

The DeForest company made and sold vacuum tubes having a drawn tungsten wire as a filament, which it bought from the Mallory company, which, it was alleged, was infringing the Coolidge patented process for making tungsten wire. DeForest, being sued as a contributory manufacturer, denied the charge on the ground that it bought the wire "over the counter" just as any other innocent purchaser might buy it. However, it was established by proof that Mallory made the wire of a certain size, that DeForest asked the wire manufacturer to make wire of a special smaller size, which it did, and that thereafter DeForest continued to buy the smaller wire at the rate of about 100,000 meters a month.

The court held that this practice of DeForest did not amount to mere casual purchases by an innocent customer, but orders given for a special improved wire, admittedly made according to the patented Coolidge process, and therefore constituted contributory infringement on the part of DeForest.

Transportation Package

Here is a case from the chemical industry which has wide application. The American Patents Development Corp. owned a patent on an invention described as a "transportation package consisting of a protective casing of insulating material having packed therein a quantity of frozen carbon dioxide in an insulating container and a quantity of freezable product in freezing proximity to said frozen carbon dioxide and the gas evaporated therefrom, arranged so that said frozen carbon dioxide is less accessible for exterior heat than said freezable product." Thus, the patent is not for solid carbon dioxide, which is old and unpatented, nor for a machine for making it, nor for a process of using it, but is for a "manufacture."

The Dry Ice Co. was the sole licensee under this patent. Its only business was making unpatented solid carbon dioxide under the trade name Dry Ice. It neither made nor sold the packages, nor did it license others to make the packages. It did not license buyers of its carbon dioxide to use the transportation packages. But with each sale of carbon dioxide it issued an invoice stating that the Dry Ice should not be used except in containers provided by it, and that its containers should be refrigerated only with Dry Ice.

The American Co. and the Dry Ice Co. charged Carbice Corp. with contributory infringement on the ground that it sold solid carbon dioxide to customers of Dry Ice, knowing that the carbon dioxide was to be used by the customers in transportation packages like those described in the patent. The court found that Dry Ice Corp. supplied only one, and that unpatented, of the several elements in the transportation package combination, for which reason it had no privilege to be free from competition. Relief was denied, because Dry Ice was trying to employ the patent on the package to secure a monopoly on the unpatented solid carbon dioxide used in the combination.

The court decided that the Carbice Corp. was not guilty of contributory infringement and could not be restrained from selling its carbon dioxide to customers who would use it in the transportation packages. The court said, "Infringement whether direct or contributory . . . . implies invasion of some right of the patentee . . . . The Dry Ice Corporation has no right to be free from competition in the sale of solid carbon dioxide. . . ."

Contributory and Direct Infringement

Finally, here is a case which may, to the layman, seem sadly mixed up, but which in fact clearly epitomizes several of the rules governing both contributory and direct infringement which apply to the chemical industry. An inventor held a patent on equipment for processing a certain unpatented product. He did not manufacture the equipment, but used it for producing the product. A competitor purchased the machine from a manufacturer who had no right to make it under the patent. The court held, of course, that the second manufacturer of the equipment was an infringer. It also held the purchaser of the infringing equipment to be an infringer. However, the purchaser of the product made by the equipment would not be a contributory infringer because the product itself was not patentable.

Finally, it is to be noted that it may or may not constitute contributory infringement to furnish repair parts for patented equipment. The rule has been stated elsewhere by the author as follows, "To supply repair parts which wear out is not infringement unless they constitute a substantial portion of the machine, unless the person is already an infringer, or unless the parts are intended to increase the pleasure or profit obtainable from the machine."

Acid-Proof Diaphragms

The possibility of using diaphragms of asbestos, asbestos compositions, chlorinated rubber and microporous ebonite for various purposes, especially for the electrolysis of aqueous chloride and sulphate solutions has been suggested by W. W. Stender, J. G. Jornitsky and B. G. Sabo of Leningrad, U.S.S.R., in a paper delivered before the recent meeting of the Electrochemical Society.

Ordinary acid-proof asbestos paper diaphragms give good performance in cells for electrolysis of acid aqueous solutions. Silicated asbestos paper has the advantage of being stiff and does not soften in acids, not even upon heating. Chlorinated rubber diaphragms are of great practical importance owing to their marked resistance to acids, alkalis and chlorine. Microporous ebonite diaphragms are resistant to hydrochloric and sulphuric acids as well as to alkalis, but not to the action of chlorine. The principal advantage of these diaphragms is that they are very finely porous.

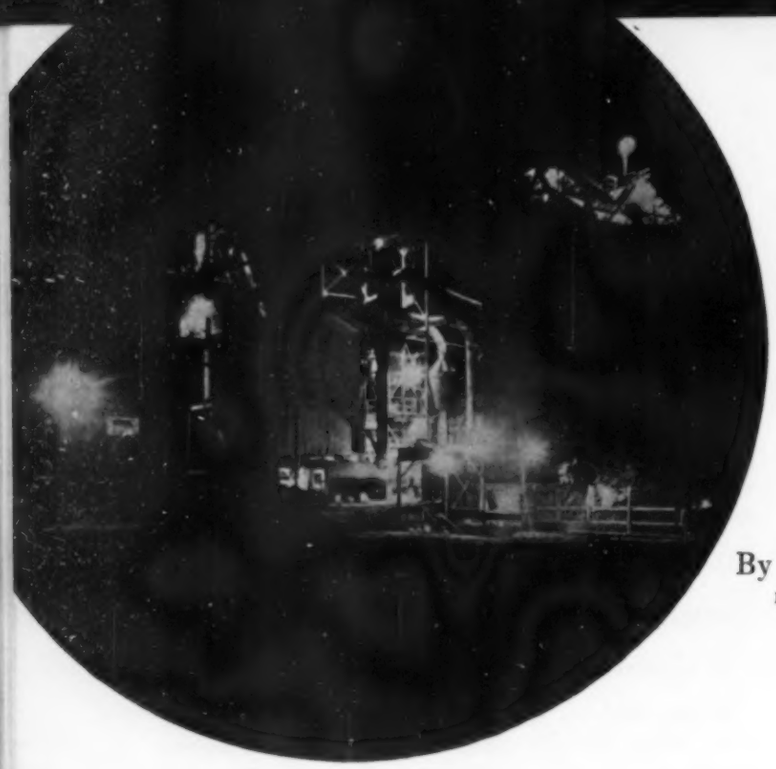


Fig. 1—Dicalite plant at Palos Verdes, Calif., operating on a 24-hour schedule, presents an unusually interesting spectacle at night

By PAUL D. V. MANNING
PACIFIC COAST EDITOR, CHEM. & MET.

Modern Production Methods In Refining Diatomite

DIATOMITE, diatomaceous earth, kieselguhr—all synonymous names for a material composed of the shells of microscopic plants deposited in either marine or fresh water—may be found fairly well distributed throughout the world. Over 10,000 different types have been identified and classified and there are many more. Deposits are often found to be very thick and a few of them are quite pure, indicating that during the Tertiary geological period, in which the large Pacific Coast deposits were formed, conditions were very favorable for this type of plant life.

Exploitation of these deposits has been carried on for many years quite successfully. The United States is by far the greatest producer in the industry with Denmark, Russia, Algeria, Germany and Japan as smaller factors. Early commercial development has been quite ably described by two authors, Eardley-Wilmot, "Diatomite", (Bulletin 691 Mines Branch, Canada), and Calvert "Diatomaceous Earth", (Chem. Catalogue Co., New York, 1930). For many years the largest production came from deposits near Lompoc, Calif., now owned by Johns-Mansville Corp. Activities at Lompoc have been described previously in *Chem. & Met.* (Vol. **35**, pp. 460-2).

The processed material was used as a filter aid, for heat insulation, as an additive to concrete, and as a filler in the manufacture of many products.

Early in 1930 a new producer, The Dicalite Co., entered the field, opening a plant at the site of the Palos Verdes deposits near Torrance, southwest of Los Angeles. It had been known for some time that a very large deposit was located beneath the rolling hills that parallel the Southern California shore line and make up what was then called the Palos Verdes Rancho, but the extent and type of diatom shell found there was not realized until Dicalite engineers began research.

First, production was carried out by tunneling through the hills, using stope and glory hole mining methods. A tunnel slightly over a mile in length was driven and this not only enabled easy production but, because of its direction, facilitated an accurate survey of the material available. The whole deposit was charted and the various strata numbered and sampled. Then laboratory tests were made on the material from each strata to place each in the proper classification corresponding to the use for which it was best suited. So far, 25 different strata have been found. Thirteen thousand acres are under lease, 450 acres being worked at present. (Shown in Fig. 2)

Inasmuch as the hills are rolling, the angles of dip of the different strata are not abrupt and it is not difficult to follow the strata, the thickness of which averages four feet. It was soon found that tunnel mining was no longer necessary and the main tunnel was closed. The raw ore is now quarried. Overburden is stripped off by a contractor using steam shovels and trucks and dumped into ravines and valleys so that the property will eventually become a level plain. Dirt handled averages about 400,000 cubic yards per year.

Once the detritus has been stripped down to first quality ore, the contractor's work ends and the company's quarrying operations begin. After the upper face is carefully

cleaned, the rock is broken out in layers with picks. This work requires some skill to insure minimum waste. Trucks then haul the ore to the plant, centrally located on the property, where some of it is stacked in long stock piles to be drawn on for plant supply when rain makes the roads unusable.

We have mentioned that over 10,000 different diatoms have been identified. All of these are by no means suitable for processing, for the finished products are quite different. When the rock is broken the best material from the Palos Verdes quarries exhibits a fibrous character, resembling asbestos to some extent. Coarser grades are suitable for heat insulating purposes. For the production of materials for other purposes the type and purity of raw material and uniformity of finished product are most important.

The Palos Verdes deposit is of marine origin and is made up of three types of diatoms known as *actinoptychus undulatus ralfs, coscinodiscus excentricus, and coscinodiscus marginatus,* predominating in *synedra (thallassis thrix) nitzschioidus gruk cilia.* Fig. 5 shows a photomicrograph of the diatoms from this deposit on a filter screen.

Several years ago, the company arranged with the owners of a large deposit underlying 1200 acres near Terrebonne, Ore., to develop the property and manufacture diatomaceous earth products there. This deposit, shown in Fig. 3, is of fresh water origin, the type of diatom being known as *stephanodiscus astraea,* predominating in the *navicula major K* and *epithemia turgida.* Fig. 6 shows a photomicrograph of these diatoms on a filter screen. With this type of diatom, it has been found possible to produce a filter aid which gives higher flow rates than previously obtained with other types. Mining and processing methods at the Oregon plant are essentially the same as those in use at the Torrance plant.

Processing the ore is necessary to separate the diatoms from each other and to remove foreign matter and moisture without breaking diatoms. When the products are to be used as filter aids, flow rates are increased by glazing the surface of the diatoms, which is done by calcination after coating with alkaline solution. Heat treating also results in increased flow rates because it makes the surfaces of the diatoms harder and smoother.

Details of the Process

By referring to a flowsheet of the process shown in Fig. 4, it will be seen that the ore which has been brought to the plant in a truck and dumped into a bin, is pulverized in a Penn swing-hammer crusher. After crushing

Fig. 2, Top—Diatomaceous earth quarries at Palos Verdes, where 450 acres are being worked at present. Note the mill in the lower lefthand corner. Fig. 3, Bottom—An airview of the Terrebonne, Ore., works. The mill is in lower center and the deposit extends throughout the view and beyond. Notice how the detritus has been stripped off up to the upper lefthand corner

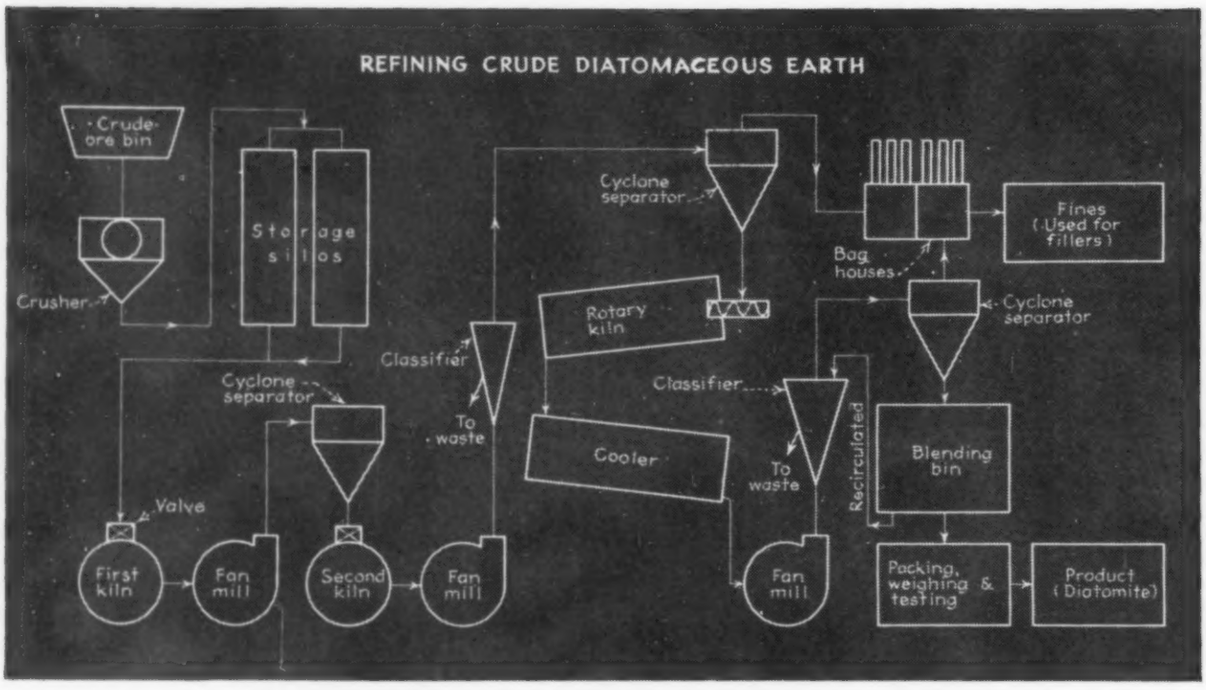


Fig. 4—Sequence of operations in processing crude diatomite

the ore is stored in two 75-ton silos without bridging of the material because of special silo design. Adjustable gates at each side of the bottom permit control and blending of the material as it leaves storage to be carried on by a pan conveyor. From this conveyor the material falls through a rotating valve into a stationary, horizontal cylindrical kiln. There it is dried and carried by a current of combustion gases at a temperature of 400-450 deg. F. into a fan so designed and operated as to further break up the aggregated material with a minimum of damage to the individual diatoms.

If the material handled is to be glazed, the solution is added at the fan intake to insure an even coating. The fan discharge passes up about fifty feet into a cyclone separator and the gases discharge to the dust eliminator. Powder thus separated passes to a second drying kiln where it is treated in a manner quite similar to the previous operation. However, this time a special type of classifier which aids in removing sand and heavier particles is interposed between the fan and cyclone separator. At this point the diatoms are dry and very light so that the discharge gases carry a lot of fines. These gases are, therefore, passed into a bag house for final separation and removal of any broken diatoms.

Powder discharges from the bottom of the cyclone into a screw conveyor which carries it into a large rotary kiln, 9 ft. in diameter and 100 ft. long, where the diatoms are burned at high temperature. It is interesting to note that this kiln was shipped to the Pacific Coast in one piece and was removed from the flat cars and transported by truck over highways through the hills, thus presenting a very unique problem in transportation. The kiln operates countercurrently, the discharge gases entering the second stationary kiln.

In certain types of products requiring very even heating throughout their course through the rotating kiln, a small amount of oil is mixed with the entering diatoms in the screw conveyor.* Solids discharge from the rotating drum into a rotating cooler. The powder and cooling air are then drawn through another fan mill and forced into a cone-type classifier and on to a cyclone separator. Powder discharges into a blending and storage bin of 70-ton capacity, while the gases go to a bag house. A screw conveyor constantly removes finished material from the bin and puts it back into the top of the classifier, where it reenters the system, passes through the cyclone and back to the bin at a ratio of four to one. This patented step insures a uniform product. From the blending bin the finished product passes to the packing equipment, is sampled and packed, then stored until the samples are tested and found to be satisfactory for the purpose desired. Laboratory tests on the product are run every two hours.

The baghouse product is used for special purposes which require an extremely fine powder, such as fillers. The Torrance plant and the Oregon plant each have a capacity of 100 tons of diatomaceous earth products per day.

A refractory insulating material made particularly for steel making and other high temperature processes is produced by kilns built in the deposit near the edge of a cliff. The kilns are filled from the top and fired from the bottom. All firing at the Torrance plant is done by natural gas, while oil is used as a fuel at the Oregon plant.

Uses of Diatomite

The uses of diatomaceous earth products are increasing rapidly, mainly due to a growing appreciation of its properties brought out by research in new fields. The so-called standard fields of usefulness, that is, heat insu-

*This step in the process covered by U. S. Patent No. 1,966,362.

lation and filtration, are showing new developments. In the field of filtration the new types of filters such as the continuous precoating filter for liquids having high volumes of solids, filter aids of higher flow rate are required and for this field a Dicalite product has been developed.

Diatomaceous earth filter aids can be classified into three groups: natural material, pink burned and white burned. The natural material, which is dried but not burned, gives a brilliant clarity or "polish" to the liquid being filtered; however, because of the soft and "hairy" nature of the diatoms, the flow rate is low. The next class of filter aid, which results from heat treating, gives a higher flow rate without loss of clarification of the liquid. White burned filter aid, obtained by heat treatment with the addition of glazing compounds, gives a harder surface and increased strength to the individual diatom. This decreases the resistance to flow of liquid, thereby increasing the speed of filtration. The clarity obtainable by use of the third class of filter aid, however, is not quite as good as that resulting from the use of the other two classes.

Filtration of beers and wines places limitations on the filter aid used. Previously a pulp was used for beer, but was expensive and for this reason was generally used over again. This method gave trouble with yeast growth and flavors. Diatomaceous earth filter aid was found to work satisfactorily, and last year over 15,000,000 bbl. of beer was filtered through Dicalite alone.

Processed diatomaceous earth is quite useful as a filler and extender, being advantageous in reducing the weight of the finished article, improving structure and acid resistance. Such uses include match heads, battery boxes, rubber asphalt, concrete, molded plastics, dynamite, paper, polishes and electrical transcription records. In concrete and plasters the workability (ease of flow) and strength are increased.

Research recently completed has demonstrated the value of processed diatomite in paints and varnishes. In addition to lowering the cost of processing, it aids in body control and cuts down the increase in body of mixed paints on standing. The life of the paint when applied is increased and blistering and peeling prevented. In certain types of paints as much as two pounds of diatomite per gallon are used. When added to varnishes the glare from the finished surface is greatly reduced and a good finish obtained without rubbing.

New uses indicated by results of research in different fields are quite interesting and full of possibilities for the chemical engineer. Removal of bacteria from a liquid by filtration through a bed of filter aid can be done. Sulphur can be freed from foreign particles by filtering it when molten through processed diatoms. One use offering savings to the paper industry is the recovery of finely divided pulp now lost in paper mill waste waters. After filtration, the filter aid passes into the product as a filler. Removal of solid or suspended particles from crude oil by filtration is another field where diatoms will help industry by removing those elements in suspension which cause erosion, thereby giving longer life to the equipment. In the field of adsorbtion, research on the processing of diatoms will undoubtedly bring results useful to industry in the future. Cooperative investigations by consumer and producer are extending the market for this raw material.

The writer is indebted to Messrs. C. A. Frankenhoff and A. L. Gossman of the Dicalite Co. for permission to visit the plants in California and Orgeon and for their interest in furnishing data on the processing and uses of diatomaceous earth.

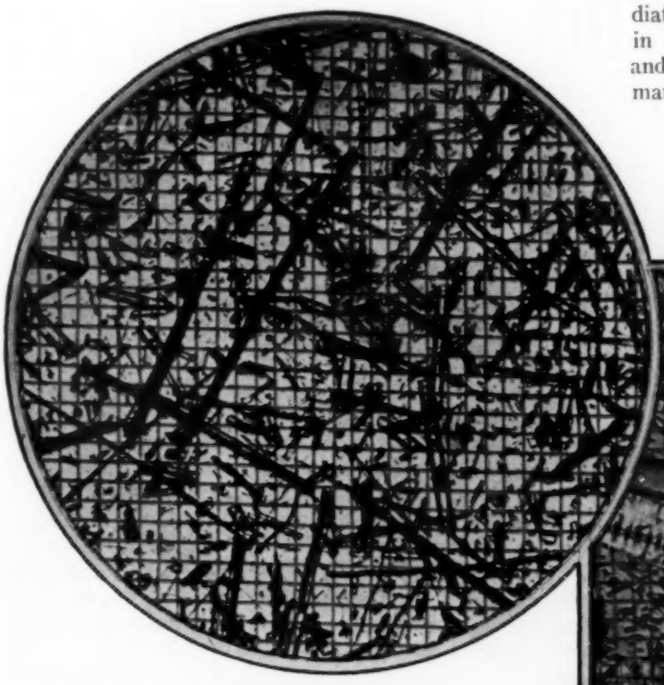
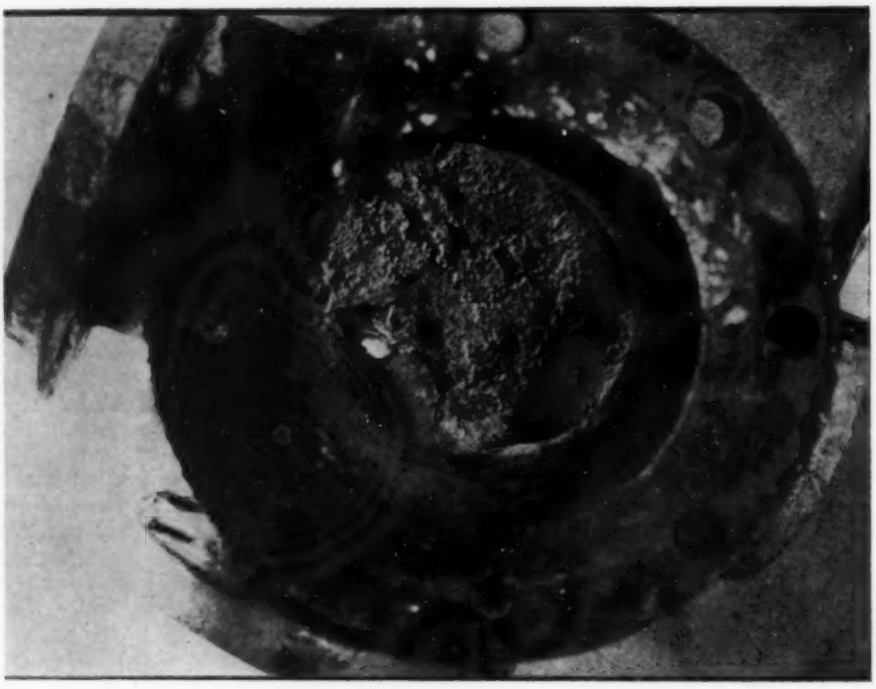


Fig. 5, Above—Photomicrograph of diatoms from the Palos Verdes deposit in California. Fig. 6, Right—Photomicrograph of Oregon diatoms. Magnification, about 360 diameters. The larger Oregon diatoms produce filter aid with a higher flow rate than those above



Cast iron double "T" in a condensate line from syrup evaporator after 14 months. Note holes through casting

By L. P. WEINER
SUPERINTENDENT,
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PEORIA, ILL.

PREVENTING CORROSION in a DISTILLERY

THE DISTILLERY has many corrosion problems, but by far the most severe are in the dryer plant. Here the grain solids in the residue or spent mash are recovered and converted into stock feed. (The other corrosion and materials of construction problems in the distillery were discussed by Mr. Weiner in the December, 1937 issue of *Chem. & Met.*, pages 710–712.)

The spent mash contains about five per cent solids. It is at a temperature of about 220 deg. F. A typical analysis includes lactic acid 0.25 and ash 0.135 per cent divided approximately as follows: silica dioxide, 0.02; aluminum and iron, 0.01; calcium oxide, 0.015; manganese oxide, 0.03; sulphates, 0.04; phosphorus pentoxide, 0.01; chlorides, 0.01.

The recovery process generally starts with a screening of the spent mash to recover as much of the solids as possible in that manner. Perforated copper sheets or woven wire screens are satisfactory if they are structurally strong enough. Muntz or admiralty metal is unsuitable as the acid etches out the zinc. Stainless steel is satisfactory for this purpose, in fact, it is the most valuable material in connection with this step in the operations. The screen frames may be made of wood but even cypress and cedar soon fall apart under the conditions encountered. Chains and other metal parts are attacked by the acid present in the liquid and vapors surrounding the screens, and are therefore unsuitable if maintenance costs are to be held to a minimum.

After the spent mash has been screened, the recovered solids are conveyed to a dewatering press for further removal of moisture, and then sent to a drying system. The water from the screens goes to evaporators where it is reduced to a syrup of from 25 to 45 per cent solids for combination later in drying machines with the solids originally removed by the screens. In some installations, the effluent from the screens is centrifuged to remove a large portion of the suspended solids and thus lessen the evaporator load to one of dissolved solids only.

Since both the screened material and the effluent are at a temperature of about 200 deg. F. and contain about 0.25 per cent acid as lactic, the corrosion problem of all equipment involved is serious. The machines generally used for drying the grain solids and combining the syrup from the screen effluent to make the feed, are the rotary drum type operating with forced draft and sometimes both forced and induced draft. In the induced draft fan system, a severe condition of corrosion at relatively high temperatures is set up, plus a plentiful supply of oxygen which follows with the high velocity of the air used to create the draft. Since the feed at some steps in the process is in solid form, it is generally moved by screw conveyors, hoppers, chutes, etc., upon which are imposed severe corrosive conditions.

The dewatering presses not only have to handle the screened material at approximately 200 deg. F., but are generally surrounded by vapors saturated with the acid from the material. All parts on these presses should be made of stainless steel and bronze, with castings of austenitic cast iron such as Ni-resist. Dewatering presses made of ordinary cast iron and steel will generally not

last more than two years under a 24-hr. day operation.

Some idea of the corrosive conditions of vapors involved in this drying problem may be obtained from the illustration on the right. The piece of iron pipe was a condensate drain line from the housing of a rotary drum dryer exhaust fan used to create the induced draft and subjected to the acid-vapor conditions. The lower left-hand corner shows a piece of what is left of a section of 5 per cent nickel steel 2 in. x 2 in. x ¼ in. L section after 15 months service. Where it is possible to fabricate it, air duct and stacks made of Transite or similar cement and asbestos combinations seem to be about the best solution at the present time. Copper, the distillers' old friend, fails completely as a satisfactory material to handle vapors which accompany the feed during drying operations. Since fans are not obtainable in Transite, the most satisfactory material available at the present time seems to be 18-8 stainless steel. Nickel steel alloys of from 3 to 5 per cent nickel have been found wanting for this service, lasting only about eight to nine months before corrosion shows appreciable effect and sometimes failing completely after 15 months service in handling the warm corrosive vapor and air.

Centrifuges, when used, should have stainless steel-clad shell and stainless steel or bronze baskets, the former being the more desirable.

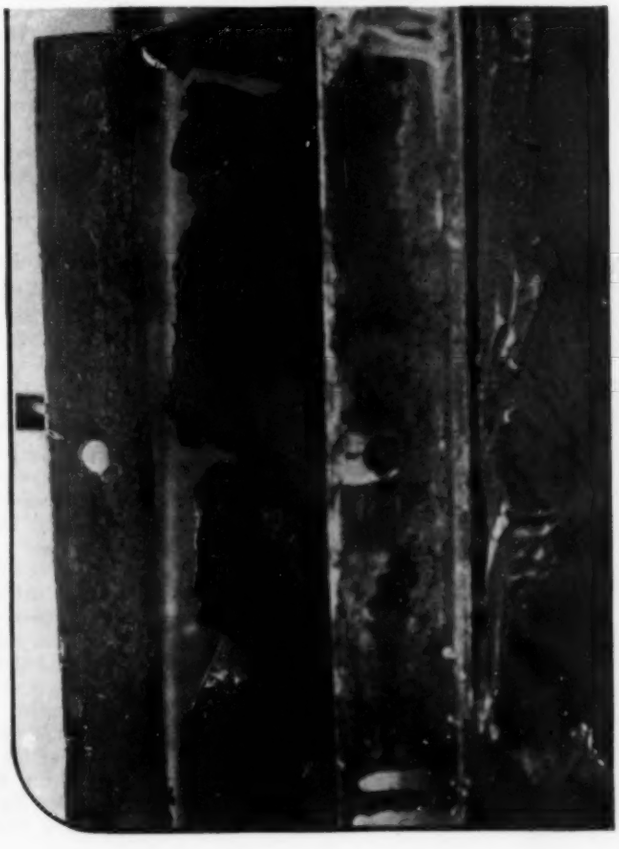
Although 5 per cent nickel steel will not stand the vapor handling, it is curiously enough satisfactory for the shells of the rotary drum dryers, possibly because the surface of the interior of the shell becomes coated with a protective film of dried feed and bits of syrup. However, in the dryers the moisture content of the feed is low and the moisture in the air is generally considerably below the saturation point. Possibly for the same reason, the steam tubes of these dryers may be of ordinary mild carbon steel with a life expectancy of eight to ten years.

The evaporators handle the thin effluent from the spent mash after it has passed through the steps of screening and/or centrifuging, concentrating this liquor to about 45 to 50 per cent solids. A typical analysis at this stage includes slightly over 8 per cent lactic acid and 3.65 ash (silica dioxide, .09 per cent; aluminum and iron, .25; calcium oxide, 1.5; manganese oxide, .13; sulphates, .17; phosphorus pentoxide, 1.5; chlorides, .01).

Cast iron evaporator bodies are used because of the high cost of other materials. An extra-heavy cast iron shell can be secured at a much lower first cost than any other material. Copper steam chests, however, are a good investment. Anyone who has tried to use ordinary steel or iron piping for evaporator service on the material discussed here, has learned that all such piping must be replaced with brass, copper or some other non-corrosive material after 12 to 18 months of service.

The dried feed is generally stored awaiting shipment in bins and may be as warm as 120 deg. F. Ordinary galvanized sheet metal bins are "money thrown away," in fact, galvanized iron or sheet metal should not be used at any place in a plant of this type. Good black iron sheets of commercial purity are thoroughly satisfactory for grain storage bins although it is doubtful if they will last more than five to seven years under 24-hr. per day operation when warm feed is stored in them.

Mixing and other conveyors handling the feed in various conditions of moisture content, should be made of muntz metal (60 per cent copper and 40 per cent zinc).



Above—Iron drain line carrying condensate from rotary dryer induced draft fan after 15 months. Below—Close-up of vane feeder opening

Chemical Engineer's BOOKSHELF

New Titles and Authors

BEARING METALS

BEARING METALS AND ALLOYS. By *Henry Norman Bassett.* Edward Arnold & Co., London, Longmans Green & Co., New York. 428 pages. Price, $8.50.

Reviewed by *C. L. Mantell*

THE AUTHOR, who is chief chemist of the Egyptian State Railways, has made a praiseworthy attempt to write an exhaustive volume on bearing metals and alloys from the viewpoint of their performance, their preparation, and the effect of additions of other metals to lead-, tin-, copper-, zinc-, cadmium-, aluminum-, and magnesium-base alloys, supplemented by a brief discussion of the applications of cast iron, compressed powder, fabric, rubber, wood and stone in bearings.

The viewpoint of the volume is Continental. The alkali and alkaline earth hardened lead alloys are treated quite completely. The widespread and extensive American development of compressed metal powder bearings is treated in little more than a page. Fabric bearings, synthetic resin impregnated and laminated materials are touched on very briefly.

The volume is replete with references which are often quoted without critical comment by the author. Considering the magnitude of the job, the author has done surprisingly well.

PAINTING WITH ALUMINUM

ALUMINUM PAINT AND POWDER. Second edition. By *Junius D. Edwards.* Published by the Reinhold Publishing Corp., New York City. 216 pages. Price, $4.50.

Reviewed by *R. L. Taylor*

THE FIELDS of useful application of aluminum powder and aluminum paint have been extended so far in the nine years since this work first appeared that the present edition is practically a new book. Twice the size of its predecessor, it covers considerably more than twice the ground. The chapter on "Aluminum Paint in the Protection of Wood," for example, is almost entirely new. Although aluminum paint with its metallic pigment seemed quite appropriate for the protection of metals, it is only recently that it has come into use as an effective wood preservative. The chapter on protection of metals with aluminum paint has been brought up to date. Also covered in this volume are some of the lesser but still important uses of aluminum powder, such as in printing inks, paper coatings, balloon fabric coatings, aerated concrete, and the manufacture of pyrotechnics. The processes for making the powder are described briefly.

Junius Edwards is well known to the aluminum industry and his qualifications for writing such a book as this need not be reiterated. It seems that he has done a complete job and a good one. The material is fairly presented, includes useful technical data, and covers most of the recent work in the field. The chemical engineer with an outdoor paint problem on his hands will find the book informative.

GAS-METAL PHENOMENA

GASES AND METALS. By *Colin J. Smithells.* Published by John Wiley & Sons, Inc., New York City. 218 pages. Price, $4.50.

Reviewed by *D. W. Murphy*

THE AUTHOR'S AIM to gather together all of the information relating to gas-metal equilibria and to correlate results from many different fields is well fulfilled in the 211 pages of this book. However, many may share with this reviewer the regret that more space has not been devoted to the practical application of the phenomena set forth. Discussion of this phase of the subject has been excluded almost entirely.

The many references cited by the author comprise an excellent bibliography of important studies in the gas-metal field dating from the pioneer researches in the first half of the nineteenth century. In addition, the text has been liberally illustrated with sketches of the apparatus used by the most successful investigators. These are accompanied by critical observations of both methods and apparatus.

The three chapters into which the book is divided, namely, Adsorption, Diffusion, and Solubility, are so written that they show the inter-dependence of these phenomena as well as the experimental difficulties involved in studying any given phase of one of them. In considering the subject almost entirely from a fundamentally theoretical point of view, the author clearly shows that the phenomenon of adsorption and diffusion have been most amenable to this type of treatment, while to a large extent the subject of gas solubility in metals is still upon an empirical basis. So much is this true that the last portion of the book dealing with solubility seems in some instances to be merely a catalog of isolated observations. This condition, however, is one which is resident in existing data, and the author can in no wise be held responsible. With regard to the chapters on adsorption and diffusion, the mass of evidence so far accumulated in support of current theories of mechanism is ably and clearly presented.

Congratulations are due the author for presenting an excellent summary of the present knowledge of gaseous adsorption, diffusion and solubility on and in metals, particularly from the theoretical viewpoint.

SYNTHETIC RESINS

THE CHEMISTRY OF SYNTHETIC SURFACE COATINGS. By *Wm. Krumbhaar.* Published by the Reinhold Publishing Corp., New York City. 157 pages plus appendix. Price, $4.

Reviewed by *J. A. Lee*

THE INTRODUCTION OF synthetic resins into the paint and varnish industry has revolutionized surface coatings. It might be said that resins have given the production man a new tool with which he has been able to fashion products never dreamed of previously. Accordingly, there is a definite need at present for detailed information on the physical and chemical principles on which the processes of every-day practice are based. The author has been associated with the development of the new type of finishes from the very beginning and has been responsible for many of the present-day coatings for automobiles and other products.

In this book the vitally important problems of chemical reactions in the varnish kettle and of surface chemistry of pigments and paints are discussed from a fundamental point of view, and in the same way drier chemistry and the physical chemistry of surface coatings are reviewed. As the author states, "It is realized that some of the basic

conceptions cannot as yet be fully supported by experiment and are not much more than reasonably founded guesses, but even so they are extremely useful, providing food for thought and actual working hypotheses." Many descriptive photomicrographs considerably assist in making visible to the eye the phenomena in question.

A chapter has been added that is devoted to the fundamentals of the composition and the application of printing inks with reference to the new possibilities offered by synthetic resins.

SYNTHETIC RESINS AND ALLIED PLASTICS. Edited by *R. S. Morrell* in collaboration with *T. Hedley Barry, R. P. L. Britton* and *H. M. Laughton*. Published by Oxford University Press, London and New York City. 399 pages. Price, $11.

Reviewed by *James A. Lee*

IN 1928, Barry, Drummond and Morrell were the authors of "Natural and Synthetic Resins." In 1932, Barry wrote "Natural Resins" to bring the first section of the subject up-to-date. The present volume gives the advances made in synthetic resins and cellulose plastics in recent years.

These British authors have attempted to cover in one treatise a subject to which Americans have devoted several volumes. They have discussed every point from raw materials to finished molded resin and cellulose products, from resins for impregnating fabrics to building materials. Our own authors have been satisfied to confine their discussions to some one phase of the many sided subject such as molding, chemistry, economics, etc. As is often the case when authors attempt to cover too many different topics, some one or two are emphasized at the expense of others. In this case the theoretical considerations involved in formation of the resins are thoroughly treated while the chemical engineering, molding and other phases of the subject have not been so well covered. Its greatest appeal would seem to be to the research chemist employed in the resins field.

ORGANIC TEXT

SYSTEMATIC ORGANIC CHEMISTRY. Third Edition. By *William M. Cumming, I. Vance Hopper,* and *T. Sherlock Wheeler*. Published by D. Van Nostrand Co., Inc., New York City. 547 pages. Price, $10.

Reviewed by *L. D. Williams*

THE AUTHORS' aim to present a "complete laboratory guide to the preparations and estimations of organic chemistry" has been well carried out in this 1937 edition. The book is completely modernized in regard to new methods and new preparations and is a most satisfactory manual. Although many of the preparations described are suitable for graduate work, the general scheme of the book makes it well adapted to the needs of beginning students in organic chemistry.

The text is divided into three parts. Part I is a general introduction. Part II is devoted to the actual preparations which are classified into groups determined by the new linkage formed by the reaction. Important physical constants, industrial methods, and literature references are given along with each preparation. Part III contains an excellent treatment of the detection and estimation of the elements in organic compounds, including the most recent micro and semi-micro methods of organic analysis. This section is particularly adapted to graduate work.

In conclusion, the reviewer can recommend the book as an excellent laboratory manual of organic chemistry, superior in its treatment of methods and use of equipment, more complete in its list of preparations, and noteworthy in its co-treatment of theory and method.

HEATING WITH OIL

OIL BURNERS. By *Kalman Steiner*. Published by the McGraw-Hill Book Co., Inc., New York City. 436 pages. Price, $4.50.

Reviewed by *T. R. Olive*

SO RAPIDLY has the science of oil burning progressed in the past two or three decades that only a sparse literature has been built up. This book, therefore, written both as a text and as a practical reference work for the oil burner and fuel oil industries, will be doubly welcome. Not only will it be of service to those who have followed the subject intensively, but it will also offer a working acquaintance with oil burning to those engineers who have only occasional need for such information. For both purposes, it appears to be well adapted.

In order that oil burning principles may be clear to all classes of reader, the author introduces his subject with a chapter on the elementary chemistry of hydrocarbons in general, and petroleum in particular, followed by discussions of the properties and combustion of fuel oil, and its comparison with competitive fuels. He then launches into a descriptive discussion of burners which he classifies as domestic, commercial and industrial; and into the various modifications of parts such as fans, motors, controls, ignition methods and pumps which are common to most burner types. Engineer readers will probably feel that the section on industrial burner applications might profitably have been expanded, although the reviewer questions whether this could have been done without the sacrifice of other equally valuable material. Concluding sections deal with methods for preheating fuel oil; with storage tanks and gages; with service and maintenance of burners; and with the methods now generally in use for the control of heating systems, principally those employed in medium and larger sized buildings.

OIL BURNING. By *H. A. Romp*. Published in English by Martinus Nijhoff, The Hague, Netherlands. 336 pages. Price, 12 guilders.

Reviewed by *T. R. Olive*

FOR THOSE intimately interested in the burning of oil in all its ramifications, Mr. Romp's book will doubtless fill a place not adequately covered elsewhere in the literature. Particularly addressing combustion engineers and the oil burner industry, the author has surveyed the state of the art throughout the world with admirable thoroughness, covering not only the earlier history, but comparatively recent practice as well. Design variations are carefully analyzed and followed through to their modern prototypes in a way which will prove most useful to designers. Clarity has been enhanced through the use of a large number of excellent drawings.

From the oil burner user's standpoint, much of Mr. Romp's material will probably prove less valuable than that found in contemporary publications. For example, for them the exhaustive information on burner design will emphasize the lack of any considerable store of information on burner application. A notable exception to this criticism, however, must be made in the case of the excellent sections covering the basic principles of oil burning. Highly technical, yet thoroughly understandable, they treat this phase of the subject in a fashion deserving of special mention.

THEORY OF FERROMAGNETISM

INTRODUCTION TO FERROMAGNETISM. By *Francis Bitter*. Published by the McGraw-Hill Book Co., New York City. 314 pages. Price, $4.

AS ONE of the International Series in Physics, this book brings a highly theoretical but lucid study of ferromagnetic phenomena. Its purpose as stated by the author is "to describe the outstanding properties of ferromagnetic substances and especially to correlate as many of these properties as possible." This it has done, but as far as most metallurgists and chemical engineers will be concerned the way to an application of the material is still not lighted sufficiently to make it of great immediate practical value. For the student of the fundamental science of metals, however, the book will be a useful tool.

LUCID PHOTOGRAPHY

PHOTOGRAPHY. By *C. E. Kenneth Mees.* Published by the Macmillan Co., New York City. 227 pages. Price $3.

Reviewed by *S. D. Kirkpatrick*

ONLY RARELY do we find that the leading scientist in a highly specialized field is, as he should be, its best public exponent. Too often there are trees that conceal the woods—details of technique and technology that confuse and confound. Dr. Mees is the exception that proves the rule. He has lived and served his industry through at least a third of its whole development. He sees its history in proper perspective and skilfully weaves the threads of art and science into the intensely interesting pattern of modern photography.

Perhaps because this book had its origin in the 1936 Christmas lectures at the Royal Institution in London, it is presented in simple, popular style. It is non-technical in the sense that it is clearly understandable by the layman—yet the technologist will find that it is remarkably accurate and complete in coverage and treatment.

Almost exactly half of the book is concerned with motion picture and color photography and their widespread applications. Theory and practice are mixed in interesting proportion as amateur and professional interests are fairly served. Accordingly, this is a book that can interest and benefit all of those thousands of people to whom photography is either a pleasant hobby or a profitable profession.

METALLFÄRBUNG. Second Edition. By *Hugo Krause.* Verlag von Julius Springer, Berlin. Printed in German. 183 pages. Price, 7.50 RM in paper, 8.80 RM bound.

Reviewed by *C. L. Mantell*

THIS VOLUME discusses from the theoretical, practical applications, and patent angles the subject of metal coloring by chemical, mechanical, and electrical methods, the latter being subdivided into cathodic and anodic procedures. The author attempts to relate all the important methods applied to iron and steel and the base and noble metals, in their sheet, cast, mechanically fabricated, or electroplated forms.

The monograph is comprehensive and will be of use as a reference and guide book to those engaged in metal coloring in its decorative as well as protective phases. Many of the so-called secret processes of the electroplating art are described in considerable detail with critical comments by the author. He has accorded American practices considerable attention. No similar book in English has come to the attention of the reviewer, so the author has satisfied a definite technical need.

GOVERNMENT PUBLICATIONS

Documents are available at prices indicated from superintendent of Documents, Government Printing Office, Washington, D. C. Send cash or money order; stamps and personal checks not accepted. When no price is indicated pamphlet is free and should be ordered from bureau responsible for its issue.

Second Semi-Annual Naval Stores Report, by F. P. Veitch and C. F. Speh. Bureau of Chemistry and Soils; mimeographed. Gives production, distribution, consumption and stocks of turpentine and rosin, April 1, 1937, to September 30, 1937.

List of Publications of the Division of Insecticide Investigations, July 1, 1927, to June 30, 1937. Bureau of Entomology and Plant Quarantine; mimeographed.

Elixir Sulfanilamide. Senate Document 124, 75th Congress, 2nd Session. Report of the Secretary of Agriculture to the Senate.

Soil Survey Manual, by Charles E. Kellogg. Department of Agriculture, Miscellaneous Publication 274; 35 cents.

The Farm Outlook for 1938. Department of Agriculture, Miscellaneous Publication 298; 5 cents. Gives estimates for agricultural production, buying power, and prospective supplies of materials for industry.

Stumpage and Log Prices for Calendar Year 1936, by Henry B. Steer. Department of Agriculture Statistical Bulletin No. 62; 10 cents.

Gallonage Tables for Horizontal Cylindrical Tanks With Flat Ends, by Elmer L. Peffer. Bureau of Standards Circular 416; 5 cents.

Publications on Polarimetry and Its Application to the Sugars and Their Derivatives, by members of the staff of the National Bureau of Standards. Bureau of Standards Letter Circular 507; mimeographed.

Acoustic Materials. Bureau of Standards, mimeographed letter circulars on: Classification of Acoustic Materials, LC-505; Sound Absorption Coefficients of the More Common Acoustic Materials, LC-506.

Low-Cost Housing. Bureau of Standards mimeographed documents on: Structural Properties of Low-Cost House Construction, LC-502A; Durability of Building Papers and Fiberboards Relative to Low-Cost Housing, LC-502B; Fire Resistance Tests of Low-Cost Housing Constructions, LC-502C; Rain Penetration in Walls, Waterproofing of Masonry Walls and the Properties of Joints in Masonry in Relation to Low-Cost Housing, LC-502D; Plumbing Materials and Equipment as Related to Low-Cost Housing, LC-502E; Investigation of Low-Cost Floor Coverings, LC-502F; Roofing Materials for Low-Cost Housing Construction, LC-502G; Surface Treatment for Corrosion Protection of Steel Members for Low-Cost Housing Construction, LC-502H; Investigation of Plastic Caulking Materials for Low-Cost Housing Construction, LC-502I; Plastic Caulking and Pointing Materials, TIBM-56; Weathering Properties of Building Brick, TIBM-57.

Effects of Feeds and Saw Speeds on Cotton Turn-Out and Quality. Department of Agriculture, Leaflet 151; 5 cents. Discussion of technical factors affecting yield and quality of products.

Cotton Production and Distribution, Season of 1936–37. Bureau of the Census, Bulletin 174; 10 cents. Includes cottonseed oil data.

Cottonseed Tests. Bureau of Agricultural Economics mimeographed documents on: Methods of Analytical Procedure for Analyzing Samples of Cottonseed and for Certificating Grades Thereof, Approved by Chief of Bureau of Agricultural Economics, July 30, 1937; Rules for Drawing and Preparing Official Samples of Cottonseed by Licensed Cottonseed Samplers, Approved by Chief of Bureau of Agricultural Economics, July 30, 1937.

Dairy Products Manufactured in Factories, 1936 by Months. Bureau of Agricultural Economics; mimeographed.

The Latin American Glass Industry and Trade, by Edward J. Detgen. Bureau of Foreign and Domestic Commerce, Trade Promotion Series No. 173; 10 cents.

Foreign Trade of Colombia for 1936. Pan American Union, Foreign Trade Series 162; 5 cents; available only from Pan American Union.

World Economic Review, 1936, Part II. Foreign Countries. Bureau of Foreign and Domestic Commerce, unnumbered document; 30 cents.

World Production and Trade in Cork. Bureau of Foreign and Domestic Commerce, Specialties Division, unnumbered mimeographed document; 10 cents.

Labor Productivity in the Leather Industry, by John R. Arnold. Bureau of Labor Statistics, Serial No. R. 596.

Certain Inorganic Pigments. U. S. Tariff Commission release of December 27, 1937; mimeographed. Statistics of domestic production and sales.

Lubricating Oil, General Information, Requirements and Methods of Test. Navy Department, Bureau of Engineering; 10 cents.

Methods and Costs of Mining and Crushing Gypsum at the Mine of the Victor Plaster, Inc., Victor, N. Y., by E. J. Lintner. Bureau of Mines, Information Circular 6967; mimeographed.

Liquid Carbon Dioxide Used to Extinguish a Gob Fire in a German Coal Mine, by Geo. S. Rice and Irving Hartmann. Bureau of Mines, Information Circular 6970; mimeographed.

Consumption of Ferrous Scrap and Pig Iron in the United States in 1936, by Robert H. Ridgway and others. Bureau of Mines, Report of Investigations 3366; mimeographed.

Hardening of Mud Sheaths in Contact With Oil, and a Suggested Method for Minimizing Their Sealing Effect in Oil Wells, by C. P. Bowie. Bureau of Mines, Report of Investigations 3354; mimeographed.

Contributions to the Data on Theoretical Metallurgy—VII. The thermodynamic properties of sulphur and its inorganic compounds, by K. K. Kelley. Bureau of Mines, Bulletin 406; 15 cents.

Review of Carbon Monoxide Poisoning, 1936, by R. R. Sayers and Sara J. Davenport. Public Health Service, Bulletin 195, 1936 Revision; 15 cents.

The Tax on the Manufacture of Manufactured Sugar Under Section 402 of the Sugar Act of 1937. Bureau of Internal Revenue, Regulations 99; 5 cents.

Official Register of the United States, 1937. Civil Service Commission, unnumbered document; $1.00.

Federal Specifications. New or revised specifications of the Federal Specifications Board on: Preservers for negative paper (photographic), G-P-641; Steel, structural, (for) bridges, QQ-S-711a; Paint, ready-mixed, international-orange, TT-P-59; Steel, structural, for buildings, QQ-S721a; 5 cents each.

Liquor Laws, August 8, 1890—August 25, 1937. House of Representatives, Document Room, unnumbered document; 15 cents.

Oil Land Leasing Act of 1920, With Amendments and Other Laws Relating to Mineral Lands. House of Representatives, Document Room, unnumbered document; 15 cents.

Statistics on Alcohol. Bureau of Internal Revenue mimeographed statements on: Statistics on Alcohol, Fiscal Year Ended June 30, 1937; Statistics on the Uses of Speciälly Denatured Alcohol, Fiscal Year Ended June 30, 1936.

Synthetic Resins in Aircraft Construction—Their Composition, Properties, Present State of Development, and Application to Light Structures, by K. Riechers. National Advisory Committee for Aeronautics, Technical Memorandum No. 841; mimeographed.

Rulings and Interpretations Under the Walsh-Healey Public Contracts Act. Department of Labor, Division of Public Contracts, unnumbered pamphlet; 10 cents.

Wood Chemical Industries of Washington, by Thomas Doumani. W. P. A. Federal Project, issued by and obtainable only from the University of Washington, Seattle, Wash.

Present Outlook for a Magnesium Metal Industry in the Northwest and a Discussion of Methods by Which Magnesium Metal May be Obtained from Magnesite Ores, by H. A. Doerner. Mining Experiment Station and State Electrometallurgical Research Laboratories, Pullman, Wash., in cooperation with the U. S. Bureau of Mines, Bulletin P; 35 cents. Obtainable only from The State College of Washington, Pullman, Wash.

Effect of City Water and Sewerage Facilities on the Market for Air Conditioning Equipment, by O. C. Holleran. Market Research Series No. 16; 10 cents.

More Books at Lower Prices

To the Editor of Chem. & Met.:

Sir:—Prof. Hugh S. Taylor's review of the book, "The Retardation of Chemical Reactions," which appeared in the November issue of *Chem. & Met.* holds more than usual interest. The title of the book, the author's name, and the authority of the reviewer's name all contribute to a desire to own this volume. Some discussion is warranted, however, in respect to Professor Taylor's statement that "the price is high."

A book that sells for $8 may easily be worth multiples of that price, but one book or a dozen books is no library or background for an individual associated with science or technology. There are a lot of $8 books and a lot of $6 books and a lot of $40 sets and some $100 sets that individual chemists and chemical engineers would like to have in their homes. But there is a limit beyond which individual incomes cannot provide for this purpose. Most important of all, I would say that the prices of individual volumes are so high that the majority of individuals consider it so hopeless to accumulate a useful private library that they make no attempt to do so.

Professor Taylor has applied his criticism of price only to this particular book. But it is possible that he had something more general in mind concerning the price of technical books. I can visualize, for instance, the problem faced by libraries and schools in maintaining adequate technical collections. In such cases, the variety of purposes to be served are more numerous than in the case of the individual. Also the number of copies of some books must be increased in proportion to the greater number of people who will have use for them. A university or college could spare $8 or some multiple of $8 more readily than could an individual, but the needs of the institution are more extensive as to different books and number of copies. So it seems to me that the prices of technical books in general are such as to limit their market in academic quarters as well as in private use.

Insofar as the market and accumulation of books among industrial firms is concerned, I am not in a position to offer comment. I have seen some nice libraries in a few instances, but I have noted in greater proportion the number of companies that do not maintain more than a skeleton array of books for the benefit of their technical workers.

The pricing policy of publishers of technical books can be understood in view of the importance of volume of sales as a factor in determining the price of a book. A technical book does not have the same ultimate market as a best-seller in popular fiction. But on the other hand I believe that the price of technical books is traveling around in one of those vicious circles—the price is high because enough people do not buy, and enough people do not buy because the price is too high.

We need some leadership in regard to dissemination and distribution of knowledge over and above the good leadership we now have in other directions. This might lie in the field of producing more good books at lower prices.

L. Carlton Mertz

L. Carlton Mertz Co.
Chicago, Ill.

CHEMICAL PATENT PROBLEMS

To the Editor of Chem. & Met.:

Sir:—In reviewing the outlook for a new edition of his "Law of Chemical Patents," this writer discovered some interesting facts concerning the relative frequency of chemical patent problems and mechanical patent problems.

It has been found by actual count in typical back issues of the *Official Gazette* that of all patents issued in the last few years, between 10 and 15 per cent were chemical patents, the exact figure depending on what is classified as a "chemical patent." If the absence of drawings in the patent specifications is used as the dividing line, the figure would be 10.5 per cent.

But let us look at some statistics on patent litigation reports and printed decisions on inventions. In the *U. S. Patents Quarterly*, 400 consecutive pages begun at random in 1935 showed 33 chemical decisions, either litigated or *ex parte* appeals, and 29 mechanical decisions. In other words, if printed decisions are a fair measure, the 10 to 15 per cent of chemical inventions cause more trouble than all the 85 or 90 per cent of mechanical inventions.

Evidently the problems of chemical patent law call for more up to date and complete knowledge of this branch of legal procedure.

Edward Thomas

Patent Attorney
New York City

IMPROVEMENTS IN ELECTROLYTIC CELLS

To the Editor of Chem. & Met.:

Sir:—In the October issue there is an article on page 597 entitled, "Germany Makes Improvements in Electrolytic Processes". This article includes the following statement: "The recently developed horizontal type Siemens-Pestalozza cell overcomes the drawback of the Billiter cell which is affected by current interruptions which often damage the diaphragms." A description of the so-called Siemens-Pestalozza cell follows and a figure illustrates it. This figure corresponds exactly to the design of the Billiter-Leykam cell, which I invented in 1913 and installed at that time in the plant of the Leykam-Josephsthal cellulose mill in Gratwein (near Graz) Austria, and which is still operating today with best results.

This cell construction was patented by me at that time. Detailed drawings of it were sent to Siemens & Halske (Berlin-Wernerwerk), who at that time were associated with me.

The so-called Siemens-Pestalozza cell is nothing but a duplication of the well-known Billiter-Leykam cell, with only slight modifications of detail which are not improvements.

In addition to this it might be pointed out that, when properly operated, the diaphragm in Siemens-Billiter cells will not be damaged by interrupting the current.

Jean Billiter

Professor, University of Vienna
c/o Copperweld Steel Co.
Glassport, Pa.

Process Equipment NEWS

Machinery, Materials and Products

Cast Refractory

MELLON INSTITUTE of Industrial Research, Pittsburgh, Pa., announces the development of a new line of refractories for extremely high temperature furnaces. These have recently been produced at the Institute by Dr. A. P. Thompson, incumbent of the Abrasive Fellowship, in cooperation with the research laboratories of the Carborundum Co. The new refractories are known as Monofrax and are produced by casting from a melt produced in an electric furnace. They are said to show extraordinary resistance to corrosive and erosive attack, particularly where the refractory is in contact with a high temperature melt such as glass or slag. One composition, it is stated, is six times as resistant to the attack of glass at 2,700 deg. F. as the best refractory previously available. A number of large scale installations in glass tanks and furnaces for the handling of molten slag have already been made.

Electric Scale Control

FOR APPLICATION to any make of dial scale, the Howe Scale Co., Rutland, Vt., has developed a photoelectric control attachment which is secured to the glass covering the face of the scale by means of suction cups. The attachment may be secured to give cut off at any desired point, or it may be arranged for ready change from point to point. Two photoelectric units may be installed side by side, if desired, in order to produce dribble feed followed by complete cut-off.

The unit consists of an incandescent light source which focuses a beam of light through the glass at a point near the spot where the pointer passes. Light is reflected back into the small slot of the photocell and is interrupted with a cut-off accuracy of one-scale division as the pointer passes. Output of the photocell is fed to a relay unit which controls a circuit of up to 300 watts, and also lights pilot lights to show whether the relay unit is open or closed. The device may be used to control hopper gates, batching equipment, control valves, or conveyors controlled by the weighing operation.

Non-Fogging Sight Glass

FOR USE in kettles and other equipment, in viewing the interior during operation, Littleford Bros., 400 East Pearl St., Cincinnati, Ohio, has developed a "shower bath" sight glass said to prevent fog from forming and obscuring the view. The 8-in. diameter aperture is kept free from fog by a constant fine spray of water under high pressure. Two beveled rings or large washers are clamped in place on the underside of the Pyrex glass disk. These washers have serrated faces providing fine channels from which water sprays on to the under face of the glass. This method is said to be applicable to all sorts of process kettles, provided that a small amount of water falling from the glass into the contents of the kettle is not objectionable.

Improved Tower Packing

AN ACCOMPANYING ILLUSTRATION shows top and bottom views of a new tower packing tile, stated to meet the most exacting requirements of gas washers, scrubbers and cooling towers, which has recently been announced by the General Refractories Co., 1600 Real Estate Trust Bldg., Philadelphia, Pa. The new tile, which has been given the name of GRCO Drip Point grid tile, is a substantially cubical unit containing a number of flues at the bottom of which are drip points. Installed regularly one over another, so as to fill the packed space completely, these units are said to be self-supporting and to permit accurate calculation of the effective scrubbing area.

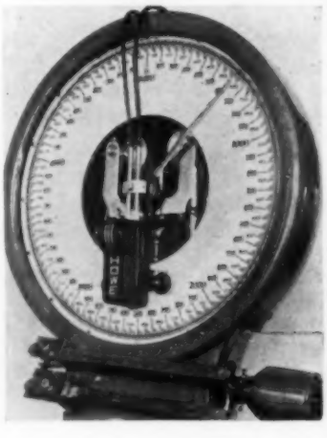
Each tile is provided with indented paneling on all sides to provide maximum effective surface. The drip points on the under surface provide a continuous uniform film of washing medium over the entire working surface. It is stated to be impossible for liquid to bypass any portion of the packing. The legs with which each tile is provided not only create a space through which the washing liquid drips, but are also said to insure perfect balance of gas pressure and so to eliminate the possibility of flue action in the packing.

These tiles are constructed of a dense, acid-resisting fireclay brick said to possess high physical strength. Other advantages claimed are that they are low in first cost, non-absorbent, refractory and rigid. They are recommended by the maker for gas washers, acid concentrating towers, absorption and cooling towers.

Pipe Cutting Machine

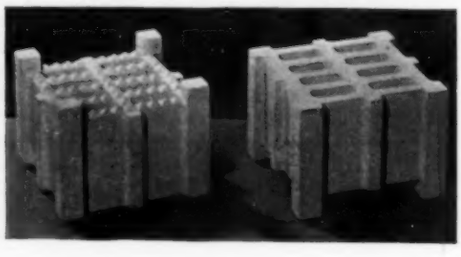
AN IMPROVED torch cutting machine for cutting pipe in sizes from 2½ to 12 in. preparatory to welding, known as No. 222, has recently been announced by the Oster Mfg. Co., Cleveland, Ohio. The new device manipulates the torch in a manner duplicating the motion of a torch held in the operator's hand, producing the appearance of a lathe tool cut, according to the manufacturer. It does not require the use of cams, templates or special fixtures. Cuts can be made at any angle so as to produce tees, reducing tees, miters, Y's and other shapes. It is stated that the settings of the generating mechanism are readily made by the operator.

Photoelectric scale-control unit

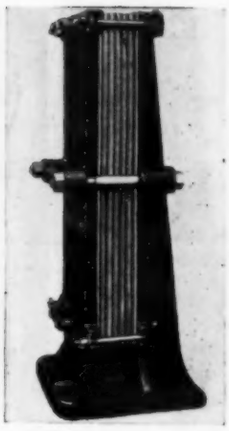


Disassembled view of "shower-bath" sight glass

Top and bottom views of drip point tile



Motor-driven blender



Experimental continuous dialyzer

High pressure valve disassembled

Agitated Blender

UNIFORM blending of asphalt cutbacks, oils and various chemical process materials is claimed for a new complete line of blenders, recently introduced by the Patterson Foundry & Machine Co., East Liverpool, Ohio. These machines are made in several sizes, in such metals as plain steel, stainless steel, clad metals and aluminum. They are built in both belt and motor-driven types.

Experimental Dialyzer

DESIGNED to facilitate experimental work in the separation of colloids from crystalloids so that the results may be applied directly to full-scale production dialysis equipment, a new laboratory model continuous dialyzer known as the Webcell has been introduced by the Brosites Machine Co., 30 Church St., New York, N. Y. As appears from the accompanying illustration, this machine is of the filter press type in which water frames alternate with frames for the liquid to be purified, such as NaOH from rayon steeping presses. Either parchment paper or cellophane can be used for the diaphragms. Each frame has one-quarter the area of a corresponding frame for the full-sized dialyzer made by this company, and with three water frames and two caustic frames, the machine has 1/120th the capacity of a full sized production model.

The laboratory model is stated to approximate closely the high efficiency of this company's production machine. Since the area bears a definite relation to that of the latter machine, a close approximation of production results can be arrived at. Standard units are made in such materials as Monel metal, stainless steel and plain steel.

High Pressure Valves

VALVES of ½, ¾ and 1 in. size for operations at 1,500 lb. pressure and 950 deg. F., have been announced recently by the Hancock Valve Division of Manning, Maxwell & Moore, Inc., Bridgeport, Conn., under the name of Hancock Duravalve. These valves are provided with an internal Stellite seat said to eliminate the possibility of leakage between the valve seat ring and the valve body.

New Products

A NEW flameproofing material, supplied in the form of a clear, non-poisonous liquid, which is stated not to be harmful to the most delicate fabrics and colors, has recently been introduced under the name of Ignex by the Laboratory Equipment Co., 148 Lafayette St., New York, N. Y. The liquid is applied by dipping or spraying and is stated to cling tenaciously to the fabric without being visible, even on black materials. It is recommended for application to both natural and synthetic fabrics, to paper, leather and other flammable materials.

FOR USE where a one-coat enamel is required, the Porcelain Enamel & Mfg. Co., Baltimore, Md., has developed a new opaque sheet iron cover coat, now being announced after numerous tests in all types of enameling plants. This new frit, designated as No. 2117, is produced by this company's continuous smelting process. In application it is fired at a comparatively low temperature and is said to produce a high gloss with an opacity higher than that of any other enamel in use.

A NEW chemical treatment said to produce permanent water repellent characteristics in fabrics has been announced by E. I. du Pont de Nemours & Co., Wilmington, Del. It can be used on practically all types of fibers to give finishes, varying according to the type of fabric and the method of application, from a soft handle, to a water repellent soft finish, stated to last throughout the useful life of the fabric. It can be applied only to fabrics dyed with fast colors or to undyed fabrics.

ACTICARBONE Corp., Lincoln Bldg., New York, N. Y., has developed a small adsorbent desiccator cartridge for use in maintaining low humidity in small spaces such as instrument and balance cases. The Actigel desiccator is provided with a tell-tale spot which is normally blue in color. When regeneration is required, this spot becomes pink. Regeneration is accomplished by heating the cartridge in an oven at 150 deg. C.

RECORDS of 50 hours duration or more have been made with one filling of the pen, according to the Permochart Co., Pittsburgh, Pa., when using a new recording chart ink recently developed by this company for use on its renewable permanent recording charts. The ink is said to start flowing instantly without flooding. It is claimed to dry quickly and yet not to cake on the pen. Three colors, purple, red and green, are available.

TWO NEW synthetic self-emulsifying waxes of interest to manufacturers of bright-drying finishes are being produced by the Beacon Co., 89 Bickford St., Boston, Mass. These are designated as Ceryl Wax O and Z. Emulsification is accomplished by melting the wax and adding boiling water with agitation. Emulsions so produced are stated to dry to an excellent gloss, yielding a film of high wear resistance and complete imperviousness to water.

FOR THE prevention of freezing in airlines, the Sullivan Machinery Co., Michigan City, Ind., has introduced a new freeze preventive known as Frosto. This material has been developed particularly for industrial applications where electric current is available for vaporizing it into the compressed air line near the compressor. A vaporizer was provided for this purpose, equipped with a thermostatic control. About 1 quart is required to treat 100,000 cu.ft. of free air under the worst conditions of temperature and humidity, according to the manufacturer.

Equipment Briefs

A NEW LINE of drop forged steel socket weld fittings has recently been announced by the Henry Vogt Machine Co., Louisville, Ky. These weld fittings are provided with socket ends to receive the pipe, thereby assuring proper alignment before and after welding. A smooth passage through pipe and fittings is assured by boring the fittings

to match the inside diameter of the pipe. Standard, extra strong, and double extra strong fittings are available in a wide range of sizes.

DEVELOPMENT of a line of explosion-proof cases for its automatic controls has been announced by the Mercoid Corp., 4213 Belmont Ave., Chicago, Ill. Although these controls use the inclosed mercury-tube type of switch and are inherently explosion proof, it is stated that certain applications are so hazardous as to require the extra protection of an explosion-proof case. The company is therefore prepared to supply such cases for its temperature and pressure controllers, as well as for transformer relays.

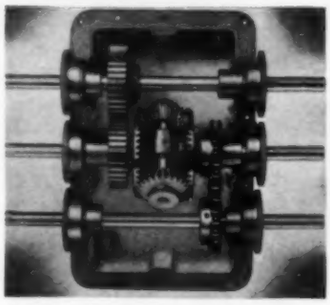
SEVERAL important improvements have been incorporated in a new design of rotary roof ventilator for industrial buildings which has recently been announced by the Swartwout Co., Cleveland, Ohio. This ventilator is provided with stainless steel inclosed dust-tight oil-less ball bearings on which the head turns with the wind. The ventilator has been designed for minimum air resistance and is supported on a welded steel tubing frame of great strength and minimum frictional resistance.

A NEW general service valve for use with steam, air, water, oil and gas, where conditions are exceptionally severe, has been announced by the Walworth Co., New York, N. Y. This is a bronze valve equipped with a seat ring and disk of special stainless steel, having a minimum hardness of 500 Brinell. Sizes range from ¼ to 2 in. in both globe and angle types. The pressure rating is 350 lb. at 550 deg. F. Owing to the exceptional hardness of the mating parts, valves of this construction are said to have remained steam-tight after more than 100,000 openings and closings.

TWO OBJECTIVES are accomplished simultaneously in an improved design of constant weight feeder which has recently been announced by the Hardinge Co., York, Pa. This feeder, which it will be recalled employs a balanced feeding belt, connected to a movable gate on the feed hopper, can now be equipped with a standard magnetic pulley, so that magnetic substances can be removed from the feed at the same time that its flow rate to the kiln or dryer is being controlled.

A NEW TYPE of screw which cuts its own thread in metals and plastics of practically any thickness, has been announced by the Shakeproof Lock Washer Co., 2501 North Keeler Ave., Chicago, Ill. As a standard thread is used, an ordinary machine screw will fit the thread, if the screw should ever need to be replaced. The screw is slotted in a special manner so as to produce a serrated cutting surface. This slot also serves to remove metal cut from the hole.

Process Equipment NEWS



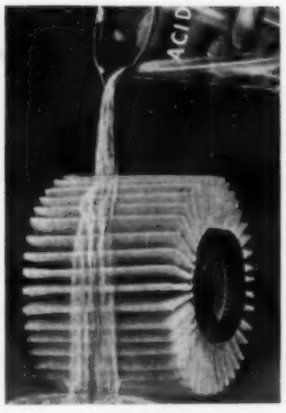
Differential for speed control applications

Transmission Accessory

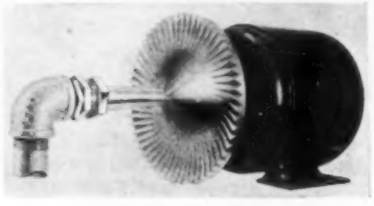
SUPPLEMENTING its line of accessory equipment for use with its variable speed transmissions, the Reeves Pulley Co., Columbus, Ind., has developed a new differential similar in principle to the type used in a motor car. It is applied in a variety of automatic speed control applications such as the synchronization of two or more machines or parts of a single machine, and in the maintenance of uniform peripheral winding or unwinding speeds. In the first application, for instance, the top and bottom shafts are connected to the driven machine or machines, while the center shaft is connected to the speed changing screw of the transmission. When the top and bottom shafts are driven in the same direction at the same speed, the central shaft does not rotate. Variation of speed of one of the driven machines, however, causes the differential to operate to rotate the central shaft and, through variation of the transmission ratio, restores synchronous speed.

Pipe Line Filter

STAYNEW FILTER Corp., Rochester, N. Y., has recently introduced a model of its Protectomotor pipe line filter, equipped with Glastex woven glass filter fabric, for use in the filtration of high-temperature and corrosive liquids and gases. The filter element, which is of the radial-fin type, is shown in an accompanying view. It is recommended by the manufacturer for resistance to all acids, except hydrofluoric, to all alkalis and gases, and to temperatures as high as 600 deg. F. Metal parts of the filter are produced in metals or alloys suitable to the desired application.



New radial-fin glass fabric filter



New rotary spray wheel

Rotary Spray Wheel

FOR USE in air washers and other equipment having banks of spray nozzles, a new mechanical spraying device known as the Murray-Preston spray wheel has been introduced by the D. J. Murray Mfg. Co., Wausau, Wis. As shown in the accompanying view, this device consists of a motor-driven grooved wheel placed opposite the center of a low pressure nozzle. Clogging of the spray wheel is said to be impossible, while large capacity and fine dispersion are claimed for the device.

Solvent Recovery Still

SPECIAL CONSIDERATION to the flammable character of most solvents has been given by the Barnstead Still & Sterilizer Co., Forest Hills, Mass., in designing a new line of solvent recovery stills. The still shown in the accompanying view was produced for separating ether from a vitamin-containing oil. Separation takes place under a vacuum in an electrically heated, water-jacketed still. Completely automatic in every respect, the still is capable of separating 10 gal. of ether per hour from the oil.

Combustible Gas Indicator

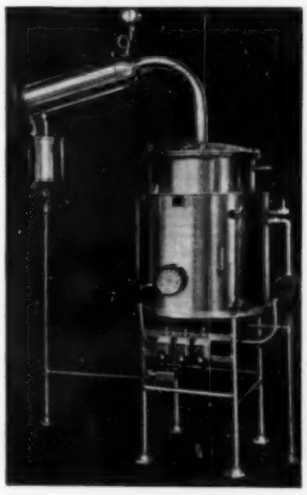
QUICK AND READY detection of explosive and unbreathable gas-air mixtures is stated to be possible with an improved line of gas indicators recently announced by The Linde Air Products Co., 30 East 42d St., New York, N. Y.

Hazardous concentrations of manufactured and petroleum gases, solvents and other flammable vapors may be determined. In one model a graduated scale indicates whether the concentration is above, below or within the explosive limits. Another model also indicates oxygen deficiency and includes a toxic chamber for determining the presence of carbon monoxide and hydrogen sulphide in dangerous concentrations. Both types are equipped with an air dilution valve of special type making it possible to detect flammable conditions which otherwise might not be indicated, due to lack of oxygen.

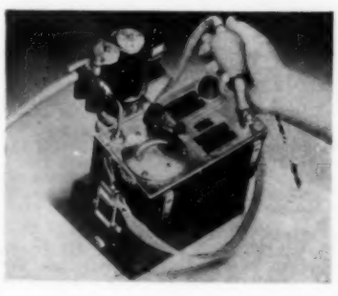
Indicating Pyrometer Recorder

BOTH recording and indicating of thermocouple temperatures is the function of a new potentiometer pyrometer recently developed by the Bristol Co., Waterbury, Conn. This instrument is of the Pyromaster type, provided with a 12-in. round chart for recording, and scale indication on a large dial. The feature of the instrument is that no mechanical motion of any kind takes place except when a change of temperature occurs. When the galvanometer is out of balance, a special relay unit operates a motor which balances the potentiometer circuit and positions the recording pen and scale indicator.

New model solvent recovery still



U.C.C. all-service gas indicator



Still More New Equipment at the Chemical Exposition

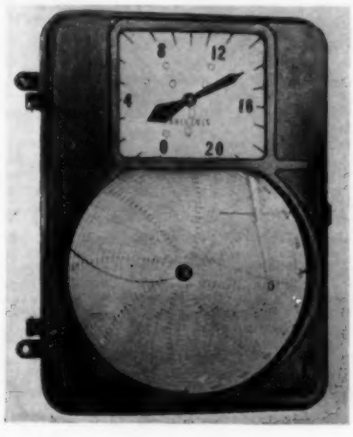
NO CHEMICAL EXPOSITION previous to the last brought forth nearly the number of new developments which *Chem. & Met.'s* editors were able to uncover at the 16th Exposition at the Grand Central Palace in New York, held during the week of Dec. 6. Despite a 20-page Exposition Preview of new developments in equipment and construction materials, which appeared in our November issue, the space available in December for those developments later uncovered at the Show proved insufficient. In this third installment, therefore, the reader will find a group of brief descriptions covering new equipment for fluids and materials handling, new packages and packaging equipment, dehydration and electrical equipment and a number of other developments, all of which, as in the cases of those in earlier pages devoted to the Exposition, were developed in the period since the Show in 1935.

Fluids and Materials Handling

American Machine & Metals, Inc., New York City, showed two models of the recently developed DeBothezat Bifurcator fan, a device for moving gases or air in ducts without material change in the direction of flow. The duct is split into two halves with the fan motor in the space between the sections. The sections join at the point where a pressure type disk fan is located. One model was shown in metal and the other with the duct sections molded of Haveg.

A new high vacuum pump capable of handling dry vacuum work at a pressure as low as 30 microns in a single stage, was exhibited by the Beach-Russ Co., New York City. The Duriron Company, Dayton, Ohio, showed a new stainless steel pump, the first of a complete line of similar centrifugal pumps.

Indicating recording pyrometer



The one shown is rated at a capacity of 1,000 g.p.m. at 60 ft. head and 1,100 r.p.m. It features ball bearing construction with all parts in contact with the liquid of stainless steel. The shaft is of steel within a stainless steel sleeve.

Hills-McCanna Co., Chicago, Ill., exhibited its Saunders valve equipped for the first time for automatic solenoid control. The valve was also shown with new Haveg and Antaciron bodies. LaBour Co., Elkhart, Ind., demonstrated an improved gland tightening device for its self-priming centrifugal pumps. This device, designated as the safety gland tightener, employs a single thumb-screw placed above the shaft and well away from any rotating part for adjusting the spring pressure on the gland. The pump features an improved support for the overhung casing which facilitates water cooling when such cooling is desired.

Lead-Lined Iron Pipe Co., Wakefield, Mass., showed two new chemical valves, one a lead-lined split body Y valve with both seat and plug readily renewable, and the other a reinforced hard lead valve featuring a construction which carries the lead covering up past the stuffing box so that leakage cannot affect non-lead parts.

Nash Engineering Co., South Norwalk, Conn., exhibited its Hytor compressor in a simplified design particularly adaptable to fabrication from special corrosion-resistant materials. An overhung rotor is used, and both intake and discharge are in the same plate. Removable liners are a feature. William Powell Co., Cincinnati, Ohio, showed a new outlet valve for tanks, autoclaves and similar equipment, featuring a flush plug which can be retracted by means of a handwheel to permit discharge. The rising stem is of the keyed type to prevent turning. The valve is made in all sizes and in any desired metal or alloy.

Barrett-Cravens Co., Chicago, Ill., showed a combination lift truck and scale which has the advantage of carrying out the operations of weighing and transporting materials simultaneously. The scale is of special rugged construction to withstand knocks and jars.

A working model of the new Johns conveyor, the machine which utilizes a two-part moving rubber pipe for conveying purposes, was displayed in the booth of the Johns Conveyor Corp., Newark, N. J. This piece of apparatus was described in detail in the November, 1936, issue of *Chem. & Met.*

A new hydraulic lift truck was exhibited by the Lewis-Shepard Co., Watertown, Mass. The platform of the truck may be adjusted hydraulically and set at a given loading level. An

hydraulic lift mechanism is then used to bring the platform to any desired height and upon release will lower and automatically stop at the original loading level.

In addition to Fiberglas filter cloth, which was described in our Show Preview, several other Fiberglas products were displayed in the booth of the Owens-Illinois Glass Co., Toledo, Ohio. One of the more significant industrial developments is the use of Fiberglas for conveyor belts. It has the advantage of being corrosion resisting and of withstanding heat up to temperatures of 750 deg. F.

Containers and Packaging

A laminated fiber-board drum with removable head and new type closure was shown by the Carpenter Container Co., Brooklyn, N. Y. A flanged wooden head and packing seal are held in place by a beaded steel rim which slips down over the top and is closed, drawn up tight, and locked by a simple lever arrangement. To remove the rim, the lever is raised and pulled back. The drums are made in sizes of from one to 60 gal.

In addition to equipment already described in our Preview section, the Karl Kiefer Machine Co., Cincinnati, Ohio, showed two new machines for packaging. One is the TL vacuum filler which first cleans a row of bottles with filtered compressed air, then fills the bottles with extreme accuracy, according to the manufacturer. The second machine is a tube filler for paste products. Its extremely novel feature is that it effects closure of the tube bottom by welding rather than folding and crimping. The tubes are first air-cleaned, then filled without bubbles or spilling. Ends of all tubes are then shaved to insure identical length and the end welded shut with a saving up to ¾ in. of the length of the tube. The machine is powered with a variable speed drive and provided with a tube counter and filling speed indicator.

A new labeling machine exhibited by the New Jersey Machine Corp., New York City, known as the Pony Labelrite is said to insure perfect register and prevent seepage of glue. The labels are drawn from a magazine up to a carrier plate by a vacuum exerted within the plate. After passing over the glue rollers where the gum coating is applied, the label is pressed on to the bottle or package by a press faced with sponge rubber.

Developments in steel drums made by the Pittsburgh Steel Drum Co., Butler, Pa., included two features. The first was a lever ring for closing the head of the drum. This is claimed to be easier to close and open than clamped, welded, or bolted rings. The second was the low-cost lacquering of drum interiors to make them useful for edible products such as vegetable oils, syrups, milk, etc., and for acids and alkalis.

Electrical and Other Equipment

General Electric Co., Schenectady, N. Y., demonstrated a recently developed magnetic thickness gage for determining the thickness of metal coatings, such as porcelain enamel. Another new development shown was this company's dewpoint potentiometer, a portable instrument for determining the moisture content of gases. This is accomplished by measuring the dewpoint or temperature at which moisture will condense from the sample of the gas. The gas is directed against a mirror which is cooled until condensate appears, whereupon the temperature is read directly on the meter by balancing the galvanometer. A recording spectrophotometer which has been under development for a number of years by this company was also exhibited.

General Electric Vapor Lamp Co., Hoboken, N. J., demonstrated a new line of ultra-violet sources known as Uviarcs. The industrial models of these lamps are being supplied for irradiation, fade testing and for various types of fluorescence analysis. The General Electric booths were illuminated with the Vapor Lamp company's Cooper Hewitt incandescent combination units in which 275 watts of mercury vapor lighting plus up to 600 watts of incandescent illumination are used.

W. A. Hammond Drierite Co., Yellow Springs, Ohio, has entered the chemical equipment field, showing two pieces of apparatus designed for industrial scale applications of its regenerable desiccant, Drierite. One is used for drying organic liquids in the vapor phase. The other piece of equipment is a two-unit regenerative system for drying industrial gases, consisting of two vertical metal cylinders which hold up to 500 lb. of Drierite each and which are so connected with an air heater and blower that one can be regenerated with hot air while the other is in use.

An improved model of its gas-fired dehydrating equipment for air was shown by the Pittsburgh Lectrodryer Corp., Pittsburgh, Pa. In this machine the dehydrating agent is activated alumina. It is said to have been improved in removal efficiency and to have been made more accessible and foolproof.

For the protection of thickener rakes against overload, the Hardinge Co., York, Pa., exhibited a new overload protection. This device consists of a surface cam cage through which the rake shaft runs, driven by the driving motor. A pin attached to the rake shaft is driven by the cage. Should an overload occur, the increased torque causes the pin to ride up an incline of the cam, thus lifting the rake over the obstruction.

Two new screen meshes were shown by the W. S. Tyler Co., Cleveland, Ohio. One, known as Ty-Rod, has long, narrow slot openings and is particularly suitable for sticky, damp or fibrous materials. The other is a rolled, flat-top mesh for use where a flat screen backing is desired.

MANUFACTURERS' LATEST PUBLICATIONS

Air Filters. Independent Air Filter Co., 228 North La Salle St., Chicago, Ill.—Bulletin D-108—8 pages on this company's double-duty automatic self-cleaning, non-clogging air filter, with complete description and engineering data.

Alloys. Alloy Metal Wire Co., Prospect Park, Pa.—36-page book listing physical and electrical properties of various metals and alloys, with information on wire and resistance ribbon made from them.

Apparatus. Fisher Scientific Co., Pittsburgh, Pa.—90-page supplement to this company's general catalog on laboratory apparatus.

Chemicals. Hercules Powder Co., Wilmington, Del.—Bulletin 654—42-page book entitled "Looking Ahead," briefly surveying this company's 25 years of progress and discussing its range of organic chemical products.

Chemicals. Hooker Electrochemical Co., Lincoln Bldg., New York City—72-page book on caustic soda with information on properties, uses and manufacture, dissolving, types and grades, handling, construction materials, analysis, packaging and other useful information. Valuable charts and tables facilitate determination of properties.

Chemicals. Mathieson Alkali Works, 60 East 42d St., New York City—36-page book describing this company's products, listing package specifications, and tabulating industries in which these products are used.

Construction Materials. Custodis Construction Co., 135 William St., New York City—1938 catalog of acidproof construction materials, with information on special masonry, acidproof cements and mortars, acid- and alkali-proof membranes, tower packing, and paints and lacquers.

Containers. Niles Steel Products Division, Republic Steel Corp., Niles, Ohio—8-page folder illustrating and describing various types of steel shipping container made by this company.

Compressors. Spencer Turbine Co., Hartford, Conn.—Bulletin 109—4 pages describing this company's centrifugal gas boosters; gives engineering data.

Conveyors. Stephens-Adamson Mfg. Co., Aurora, Ill.—Catalog 17—124 pages covering in detail belt and bucket conveyors, the design of installations and the choice of a variety of auxiliary equipment.

Cooling. Binks Manufacturing Co., 3114 Carroll Ave., Chicago, Ill.—Catalog including a series of bulletins on forced and induced draft and atmospheric

spray cooling towers and industrial spray nozzles.

Dehydration. Pittsburgh Lectrodryer Corp., Box 1706, Pittsburgh, Pa.—4-page booklet briefly describing certain types of this company's equipment for air conditioning and industrial dehumidification.

Diaphragm Valves. American Schaeffer & Budenberg Instrument Division, Manning, Maxwell & Moore, Inc., Bridgeport, Conn.—22-page catalog on types, design and characteristics of this company's diaphragm motor valves for control.

Dust Collectors. Northern Blower Co., West 65th St., Cleveland, Ohio—Bulletin 500-3—4 pages with engineering data describing this company's square type tubular-element air filters.

Dust Control. Mine Safety Appliances Co., Braddock, Thomas & Meade Sts., Pittsburgh, Pa.—Booklet listing 73 questions and answers concerning industrial dusts and their control through respirators and masks.

Dust Collectors. Claude B. Schneible Co., 3951 Lawrence Ave., Chicago, Ill.—Bulletin 110—16 pages describing and illustrating this company's Multi-Wash system of dust collection.

Dust Collectors. W. W. Sly Mfg. Co., 4700 Train Ave., Cleveland, Ohio—8-page non-technical discussion of the dust problem in business, with reference to health, legislation and methods of dust control.

Electrical Equipment. Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill.—Bulletin 1410—4 pages describing vertical hollow- and solid-shaft polyphase squirrel-cage motors.

Electrical Equipment. General Electric Co., Schenectady, N. Y.—GEA-1368C—4 pages describing vertical hollow-shaft induction motors for deep well pumping.

Electrical Equipment. Zenith Electric Co., 607 South Dearborn St., Chicago, Ill.—6-page bulletin on magnetic contactors, remote control switches, and automatic time switches and interval timers.

Enameling. Ferro Enamel Corp., 4150 East 56th St., Cleveland, Ohio—New "Manual of Porcelain Enameling," containing 522 pages of technical and practical information on all phases of porcelain enameling. Available at $5 per copy.

Equipment. Commercial Shearing & Stamping Co., Youngstown, Ohio—28-page book on tank heads, tank accessories, boiler heads and other stampings, produced by this company for a wide variety of purposes.

Equipment. The Dorr Co., 570 Lexington Ave., New York City—Bulletin 7071—8 pages briefly describing and illustrating this company's complete range of process equipment including agitators, mixers, aerators, classifiers, washers and thickeners.

Equipment. Haveg Corp., Newark, Del.—Bulletin D-1—8 pages illustrating and describing this company's standard rectangular tanks and accessories, manufactured from Haveg.

Equipment. Hardinge Co., York, Pa.—Bulletin 41—12 pages of representative operating data on this company's equipment for grinding, classifying, thickening, feeding and drying, with brief descriptions of equipment.

Equipment. Hell & Co., 3088 West 106th St., Cleveland, Ohio—Bulletin 42—4 pages dealing with methods of heating corrosive liquids, covering steam, gas and electric tank heating equipment and giving piping diagrams.

Equipment. Leader Iron Works, Decatur, Ill.—8-page bulletin illustrating and briefly describing a wide range of process vessels, fabricated by this company of special metals and alloys.

Fans. Northern Blower Co., West 65th St., Cleveland, Ohio—4-page booklet describing, with engineering data, this company's high-speed, low-power exhaust fans.

Filters. Filter Media Corp., Irvington-on-Hudson, N. Y.—4-page folder describing properties of woven glass filter fabrics, with information on available types.

Gears. Philadelphia Gear Works, G St. and Erie Ave., Philadelphia, Pa.—72 pages with engineering data on this company's gears and gear products, including speed reducers, valve operators and electric hoists.

Hose. Chicago Metal Hose Corp., Maywood, Ill.—4-page bulletins describing insulated metal steam hose and uninsulated metal oil hose.

Hose. Manhattan Rubber Mfg. Division, Raybestos-Manhattan, Inc., Passaic, N. J.—4-page folder describing and illustrating applications of this company's industrial rubber hose.

Instruments. The Bristol Co., Waterbury, Conn.—Bulletin 496—Outlines various improvements recently made in this company's recording voltmeters and ammeters.

Instruments. Brown Instrument Co., Philadelphia, Pa.—Catalog 5001—24 pages on this company's equipment for automatic boiler regulation; also Folder 84-9, six pages describing this company's colored numerical recording system for pyrometer recorders.

Instruments. The Foxboro Co., Foxboro, Mass.—Bulletin 198-1—40 pages describing this company's recording thermometers, with information on accessories and installation; also Bulletin DMF-726, 4 pages on flowmeters for 1,500 lb. working pressure.

Insulation. Refractory & Insulation Corp., 381 Fourth Ave., New York City—Bulletin I-61—Leaflet describing a type of insulation for large areas combining a flexible insulating blanket with a one-coat hard surface finish.

Lead. Andrews Lead Co., 30-48 Greenpoint Ave., Long Island City, N. Y.—16-page booklet on lead, giving physical and chemical properties together with technical data on various grades and on corrosion resistance.

Metal Spraying. Stevens Metal Spraying, Inc., 81 Shipley St., San Francisco, Calif.—8 pages briefly describing metal spraying equipment and application.

Mixers. Abbe Engineering Co., 50 Church St., New York City—Bulletin 43—8 pages discussing in some detail a variety of Abbe-Lenart mixers made by this company.

Mixers. Mixing Equipment Co., 1054 Garson Ave., Rochester, N. Y.—4-page leaflet describing special construction features of a variety of this company's agitators; also leaflet on features and specifications of laboratory mixers.

Pipe Joints. U. S. Stoneware Co., Akron, Ohio—16-page book describing in detail construction and use of this company's Flexlock rubber joints for chemical stoneware pipe lines.

Plastics. Bakelite Corp., 247 Park Ave., New York City—4-page folder describing electrical, physical and chemical properties of this company's polystyrene molding material.

Power Transmission. Foote Bros. Gear & Machine Corp., 5301 South Western Blvd., Chicago, Ill.—Bulletin 601—Detailed ratings, specifications, dimensions and descriptions of this company's vertical agitator drives.

Pumps. Beach-Russ Co., 50 Church St., New York City—Bulletin 62—Leaflet illustrating this company's acid-resisting centrifugal pumps.

Refrigeration. Ingersoll-Rand Co., 11 Broadway, New York City—Bulletin 9144—32 pages describing in detail principles and application of centrifugal water vapor refrigeration as perfected by this company.

Safety. Mine Safety Appliance Co., Braddock, Thomas & Meade Sts., Pittsburgh, Pa.—Leaflet giving detailed description of the mercury vapor detector described in *Chem. & Met.'s* Chemical Show Preview.

Safety. Pulmosan Safety Equipment Corp., 176 Johnson St., Brooklyn, N. Y.—Folder describing equipment for the safe handling of acids and chemicals, including carboy trucks, tilters and drainers; safety clothing; goggles and respirators; and other equipment.

Separators. S. G. Franz Co., 161 Grand St., New York City—16 pages describing the several types of magnetic separators for slips, enamels and other liquids made by this company.

Shipping. Acme Steel Co., Chicago, Ill.—Folder describing this company's unit-load system of shipping, with particular reference to shipment in pool cars and stop-over cars.

Steam Production. Cochrane Corp., Philadelphia, Pa.—Publication 2725—12 pages on this company's steam purifiers, with information on benefits derived from their use in a variety of applications.

Tanks. A. M. Byers Co., Pittsburgh, Pa.—32-page book on the use of wrought iron for tank construction. Gives service records of old wrought iron tanks and information on many recent installations.

Tantalum. Fansteel Metallurgical Corp., North Chicago, Ill.—32-page booklet on uses of tantalum for acidproof equipment, discussing production and physical properties of tantalum, chemical properties and certain specific applications in heat transfer and absorption equipment, instruments, valves, spinnerets, and agitators.

Tubing. Timken Steel & Tube Division, Timken Roller Bearing Co., Canton, Ohio—40-page booklet with data and tables of useful information on seamless mechanical tubing.

Valves. Hancock Valve Division, Manning, Maxwell & Moore, Inc., Bridgeport, Conn.—Bulletin 7500-C—8 pages with description, uses and prices covering this company's Flocontrol valves; gives data on capacities and discharge characteristics; also 4-page bulletin describing this company's new Duravalve for high-temperature, high-pressure service.

Valves. Newman, Hender & Co., Ltd., Woodchester, Glos, England—Catalog 55-M—46 pages on this company's Newman-Milliken glandless lubricated plug valves, with engineering data covering a wide variety of types.

Water Treatment. Bird-Archer Co., 122 South Michigan Ave., Chicago, Ill.—42-page book on water treatment, types of water, and types of treatment in which this company specializes.

Welding. Lincoln Electric Co., Cleveland, Ohio—22-page book with many illustrations showing how to change over to welded design.

Welding. The Linde Air Products Co., 30 East 42d St., New York City—16-page booklet describing fire hazards met in welding and cutting, and their prevention.

Wire Conveyors. Cambridge Wire Cloth Co., Cambridge, Md.—8-page bulletin describing a variety of Monel metal woven wire conveyor belts made by this company.

Chemical Engineering NEWS

PACKAGING AND SHIPPING PROBLEMS TO BE DISCUSSED AT CHICAGO

Preliminary plans have been formulated by the Packaging Council of the American Management Association for a more intensive and broader discussion of current packaging, packing and shipping problems at the association's 8th Packaging Conference, to be held in the Palmer House, Chicago, March 23 to 25, it is announced by Alvin E. Dodd, president of the association.

The Conference will be held concurrently with the Eighth Packaging Exposition and the showing of entries in the Seventh Irwin D. Wolf Awards competition, both also sponsored by the American Management Association.

The Conference program will tackle four major subjects: the unit package; packaging machinery; shipping and shipping containers; and bulk packaging.

Subjects and speakers for the unit package sessions, which will be held on Tuesday and Wednesday, March 22 and 23, are now being developed by a committee of the Packaging Council.

The packaging machinery program will be held on Tuesday, March 22. Program details are in the hands of a committee of which H. H. Leonard, vice-president of the Consolidated Packaging Machinery Corp., is chairman.

Two days—March 23 and 24—will be devoted to shipping and shipping containers. The committee in charge of this division, headed by Albert W. Luhrs, president of the Container Testing Laboratories, acting in conjunction with J. H. Macleod, vice-president of the Hinde & Dauch Paper Co., has already drafted a program and tentatively selected speakers.

Bulk packaging sessions will be held on Friday, March 25. Chairman of the committee developing this program is R. W. Lahey of the American Cyanamid Co.

Presentation of the Irwin D. Wolf Awards for Distinctive Merit in Packaging will be made at a luncheon held on Tuesday, March 22.

More than 95 per cent of all available exhibit space in the Eighth Packaging Exposition had been leased by December 15, it is announced by the association and an unusually large representation is assured.

Hydroelectric Projects Under Investigation

In an unprecedented move the Federal Power Commission on Dec. 17, invoked the investigatory provisions of the Federal Power Act against companies owning and operating hydroelectric power developments on the Yadkin River in North Carolina, and ordered investigations of five large hydroelectric projects on that river.

The situation on the Yadkin River was brought before the Commission directly by the filing of a declaration by the Carolina Aluminum Company of its intention to construct a hydroelectric power plant near Tuckertown on the Yadkin River in North Carolina, upon which declaration the finding of the Commission was recently made. This declaration of intention disclosed the location of five hydro plants on the Yadkin River between Salisbury, North Carolina, and Cheraw, South Carolina, which appear to affect the navigable capacity of the Peedee River in South Carolina, a stream which at one time carried millions of dollars worth of commerce.

After exhaustive investigation and consideration of opposing claims made by the States of North Carolina and South Carolina, the Commission found that the Tuckertown development proposed by the Carolina Aluminum Company would affect the interests of interstate commerce, thus sustaining the plea of the State of South Carolina and requiring a Federal license. Petitions for rehearing of the Commission's Tuckertown decision on behalf of the Carolina Aluminum Co. and the State of North Carolina were denied by the Commission.

The orders adopted by the Commission institute investigations on its own motion of three existing projects of the Carolina Aluminum Company and two power projects of the Carolina Power and Light Company, now in operation on the Yadkin River, in North Carolina, to determine whether orders "appropriate, expedient, and in the public interest should issue to conserve and utilize the navigation and water power resources of said region."

Fertilizer Industry Will Renew Educational Work

The fertilizer industry through the Soil Improvement Committee of The National Fertilizer Association is planning an enlarged program of educational work. This was decided at a convention of the industry held in November in Atlanta. The national Soil Improvement Committee will cooperate with local district committees in carrying on this work. Henry S. Parsons of New York is chairman of the national Soil Improvement Committee and vice-president of the Association.

At a later meeting of the national committee held in Chicago further plans for cooperating with the district soil improvement committees were made, and H. R. Smalley, chief agronomist of the Association, was elected director of soil improvement work.

In developing its work the national Soil Improvement Committee and the district committees will cooperate with state agricultural colleges, experiment stations, and extension services, with the United States Department of Agriculture, county agricultural agents, teachers of vocational agriculture, the farm press, and all other agencies interested in agricultural improvement.

Wheeler McMillen Heads Chemurgic Council

Wheeler McMillen, editorial director of *The Country Home* and noted agricultural authority, has been elected to succeed the late Francis P. Garvan as president of the National Farm Chemurgic Council. The election of Willard H. Dow, president of the Dow Chemical Co., Midland, Mich., as vice-president representing Industry in the Council also was announced. This office was formerly held by the late Howard E. Coffin. Louis J. Taber, Master of the National Grange, will continue as the Council's vice-president representing Agriculture. The vice-president for Science is Dr. Roger Adams, head of the University of Illinois' chemistry department and former president of the American Chemical Society.

Specialized Tank Cars Aid In Shipping Chemicals

"Industry is providing on an increasingly larger scale specialized types of equipment to meet their individual needs," V. R. Willoughby, general mechanical engineer of American Car and Foundry Co., said last month before the New York Chapter of the Railway & Locomotive Historical Society.

Mr. Willoughby cited lead-lined tank cars provided for the shipment of sulphuric and other acids; rubber-lined tank cars for muriatic and phosphoric acid and formaldehyde, and the nickel-clad cars for caustic soda. He credited the development of specialized cars to the coordinated efforts of the manufacturers of the products shipped and the car-builders.

"Liquid sodium," he went on to explain, "is shipped in especially designed welded tanks. All air is excluded by means of nitrogen, then tank is filled with the liquid metal which is allowed to solidify; so that while in transit the sodium is a solid mass. Upon arrival at destination, it is melted by means of circulating hot oil through the coils which are welded to the outside of the tank shell."

"As in the transportation of liquids in bulk, equally great advances have been made in the handling of dry bulk commodities," he went on to say. "An especially interesting development is in the transportation of carbon black which is largely used in the manufacture of tires. Prior to the advent of the weather-tight hopper cars, carbon black was shipped in box cars in sacks," said Mr. Willoughby. "This year probably one-half of the carbon black assigned to the tire companies will be shipped in bulk."

Hydrogen Peroxide Used in German Tobacco Trade

According to a report from the American Consulate-General at Frankfort-on-Main a chemical process for improving inferior, heavy grades of tobacco, involving the use of hydrogen peroxide, introduced in Germany in 1936, has been making considerable progress commercially of late and the prospects are that in the not distant future the process will be adopted for treating all German production of heavy grade tobacco. The process has been tested exhaustively and found to be practical for improving the quality of German tobacco which hitherto, because of its heavy and inferior grade, was unsuitable for smoking purposes and was used largely for obtaining nicotine for insecticide purposes. However, a serious obstacle to its widespread commercial adoption was the legal requirement contained in the so-called "Deklarationsverordnung" that all tobacco offered for sale that has been chemically or otherwise artificially treated for improving its quality bear a clear indication setting forth the nature of such treatment. Owing to the unfavorable psychological effect of this required publicity of artificial treatment, the commercial development of the chemical improvement process has been considerably retarded. It is now reported that the legal requirement of public declaration will shortly be abolished as regards the leading "Merck-Degussa" tobacco-improvement process and that with its abolition adoption of the process will gain rapidly until Germany's entire production of heavy tobacco will be processed by it.

The report states that aside from reducing the nicotine content of the heavy grades of tobacco, the process also reduces other unsuitable elements. A particularly favorable characteristic of the process is that until now it is the only one that has been developed that enables treatment of the tobacco already in its first preparation stages, thus avoiding any injury to the external structure of the tobacco leaf, while achieving maximum results in improved quality.

Schedules for 1937 Census Data Mailed This Month

The Biennial Census of Manufactures, covering the calendar year 1937, gets under way on Jan. 25, when schedules will be mailed to manufacturers throughout the country, announces Director William L. Austin of the Bureau of the Census. The census will cover all manufacturing establishments in the United States making products valued at $5,000 or more during 1937.

The Census Bureau has set a goal of greatly increased timeliness in issuing the reports of this canvass. The Division of Manufactures has been completely reorganized and strengthened towards this end. Cooperation of manufacturers in returning schedules promptly is necessary, however, if this goal is to be attained. Prompt publication of the figures will greatly enhance their value and the Bureau is making every effort to set a speed record in the collection, compilation and publication of the reports of the Biennial Census of Manufactures, 1937.

Leading manufacturers and trade associations participated actively in drawing up the schedule used in the canvass. Every effort was made to restrict inquiries to those which will yield the maximum of usefulness with the minimum of trouble in reporting. Manufacturers are assured that their reports to the Bureau are confidential and cannot be used for purposes of taxation, regulation or investigation.

Herty Honored at Opening of Florida Paper Mill

On Jan. 14, the first unit of the new $9,000,000 paper mill of the Kraft Corp. of America, subsidiary of the Container Corp. of America was formally dedicated at Fernandina, Fla. By proclamation of Gov. Fred P. Cone the date was established as "Florida Industries Day" to direct attention to the importance which the newly established kraft paper industry carried to the South. The dedication ceremonies were especially arranged to pay tribute to Dr. Charles H. Herty for his work in chemical research which made possible the growth of southern kraft industry.

P. C. Kelly, mayor of Fernandina, acted as host at the dedication. Walter P. Paepcke, president of the Container Corp., unveiled a plaque in honor of Dr. Herty. Addresses were delivered by Daniel C. Roper, Secretary of Commerce; Governor Cone; Senator Claude Pepper, and James G. Stahlman, president of the American Newspaper Publishers Association.

Preceding the ceremonies at Fernandina, the visiting group of state executives, industrialists, editors, and financiers was entertained at breakfast in the Hotel George Washington at Jacksonville, with the Jacksonville Chamber of Commerce as host. In the evening at the same hotel Governor Cone was host at a State Dinner with Colonel Harold Colee, president of the Florida State Chamber of Commerce, serving as toastmaster.

Increase in Production of Naval Stores

Naval stores producers made 116 thousand barrels of rosin and 36 thousand barrels of turpentine more during the first 6 months of the 1937-38 season (April-September) than they made in the same period of the previous season, according to the U. S. Department of Agriculture's second semi-annual report on production, consumption, and stocks of naval stores. The carryover of both turpentine and rosin was larger on September 30, 1937, than on April 1, 1937.

The increase, according to Dr. F. P. Veitch in charge of the Naval Stores Research Division of the Bureau of Chemistry and Soils, is due to increased production of both gum naval stores, and of wood naval stores.

During this 6 months period the production of gum naval stores was increased by 16 thousand barrels of turpentine and 27 thousand barrels of rosin while the production of wood naval stores was increased 20 thousand barrels of turpentine and 89 thousand barrels of rosin compared to the same period in 1936. There was a decrease in imports of both turpentine and rosin during this period.

NEWS FROM WASHINGTON

Washington News Bureau
McGraw-Hill Publishing Co.
Paul Wooton, Chief

PRESIDENT ROOSEVELT laid before Congress on January 3 a list of duties not essentially different than that which he has been pressing on the legislators for nearly a year. He insists that the need for wage-hour standards is not lessened by the blow given that proposal in the House of Representatives during December. Agricultural production control, government reorganization, encouragement of housing and, by mild suggestion, further national planning, are in their familiar places on the Congressional agenda. Moved forward to the spotlight position is antimonopoly talk, but there is no evidence in Washington that a specific bit of legislation has been prepared or will soon be ready for Congressional study.

Tax Adjustment

Presidential admission that further tax adjustments are necessary for the good of business clears away the last excuse which Congress has for further extended delay. It is to be expected, therefore, that modification of corporation profits taxes and some amendment of capital gains levies will be accomplished by Congress within the next two months. These changes will not, in any event, give relief to corporations for earnings of 1937.

A tentative agreement has been reached for the abolition of a number of the nuisance levies which have plagued industry and the public. A subcommittee of the House has indicated that despite a prospective revenue loss of about $25,000,000, it is intended to abolish these taxes on cameras, furs, brewers wort and malt, toilet soap and toothpaste, chewing gum, sporting goods, phonograph records, and crude oil. No large budgetary or general industry significance attaches to these or related changes.

Budget

Budget estimates submitted by the President January 5 forecast substantial economies in highway and other public works spending, and in direct relief, work relief, and C.C.C. activities. Should these be accomplished, and no greater agricultural spending be permitted than is budgeted, the fiscal year ending July 1, 1939, would add but a billion to the public debt. Even optimistic realists anticipate that greater relief and construction spending will be authorized by Congress. Therefore, the taxpayers or those who loan to the Government, must provide both for the present fiscal year and the next in the neighborhood of $1.5 billion, instead of $1.0 as estimated. And even this larger forecast of deficits does not assume as great a shrinkage in Government income from taxes as may occur if the present recession is not soon relieved.

Perhaps the most persuasive evidence that the President is really striving for curtailed spending is the action of December 31, cutting the bonus on domestically mined silver from 77+ cents to 64+ cents. By this action the President placed economy ahead of western mining state popularity.

New Power Troubles

The dirty linen of T.V.A. is to have Washington laundering. Senator Norris would prefer to have this done in the relative privacy of the Federal Trade Commission, seeking facts and not reputation smearing. Critics of the T.V.A. and of public power projects are seeking the megaphone of a Senate committee in order to strengthen their voices as they offer testimony.

Pending a clearing up of the bitter T.V.A. controversy, there seems little likelihood that seven Little T.V.A.'s can have any serious Congressional encouragement. The fact that the President only casually alluded to them, as a side issue connected with national planning as a part of Government reorganization, makes it appear that there will be no further effective pressure in this direction for some months to come. In fact this represents the only significant omission from the list of wanted legislation presented to Congress by the President's message.

Federal Power Commission has vigorously injected itself into the hydroelectric situation of importance to process industry, by two sets of orders. The first announced an inquiry on the unlicensed projects on the Yadkin River, including particularly the developments of Carolina Aluminum Co., intended to augment the primary aluminum making capacity of America. Less than a week later, as a Christmas present to the hydroelectric industry, the Commission announced that it would broaden this investigation to include a study of all unlicensed hydroelectric power projects in the entire country.

The objective of F.P.C. is clearly more intimate federal control of water resources on the upper reaches of rivers and their tributaries where navigation is, in fact, never possible. The theory is that occupancy of such streams by these projects affects the navigation and usefulness of the rivers far below the points of power generation. This effort is apparently to crystallize the long evident desire of Federal Power Commission to secure control of waterway facilities clear back to Farmer Jones' cow-pasture creek.

Technical departments in Washington continue to press vigorously their favorite suggestions as to new means for power utilization by electrometallurgical and electrochemical enterprise. Most conspicuous during the past month has been the report issued jointly by the Bureau of Mines and State College of Washington, discussing the feasibility of making magnesium on a large scale at some of the Western federal power projects. The availability of abundant power at Grand Coulee, with nearby magnesite resources, is assumed. The conclusion reached, none too persuasively, is that new processes for carbon reduction using electric heating will make magnesium very much cheaper and the manufacture on a very large scale will thus follow. The suggested new methods are not given in detail, but further work toward them is promised.

Apparently power development as a part of national planning is to be a very minor consideration in the future. More emphasis is likely to be placed on water supply, irrigation, and mineral resource development. Even the first Supreme Court decision of January, unanimously legalizing the spending of federal funds to aid municipally or other regionally owned power projects, is not likely to put hydro property development with federal aid back into any important position with the planners.

Business Trends

Official Washington hopes, but not too confidently, that renewed industrial buying will become necessary soon, because of low inventories. Career officials and non-political economists agree that such purchasing will permanently stimulate manufacture and re-employment more successfully than all of the artificial Government efforts combined. A little hope is generated by the evident intention of Congress to enact housing aid legislation soon. But the benefits of that would be "too slow."

The fact that this was a commodity recession is no longer seriously doubted in Washington. Admission that much

of it may be merely a headache following political orgies of earlier years is encouraging to conservatives, but does not offer fundamental remedies. The natural intention of business to expand as rapidly as conditions permit is expected to give large result during 1938, almost regardless of political factors.

The crisis psychology which surrounds treatment of railroad problems did not stampede I.C.C. into immediate blanket freight increases. But some rather general advance in freight rates is expected before Spring. Contract truck rates will probably be advanced in an equivalent amount. This may merely push more freight into privately owned trucks. But I.C.C. and the railroads hope, apparently believe, that it will not work that way.

Price declines which have caused much business distress are blamed, at least 50 per cent, on surpluses and declining demand for farm products. Reduction in commodity volume, on the other hand, is blamed about one-third on steel, one-fourth on textiles, and the balance generally distributed and perhaps secondarily the effect of these two primary declines. From these analyses, which have at least quasi-official status, the chemical industry can judge as to its prospects and share in the problem. No one in Washington finds any justification for believing that the present recession includes major factors of long-depression-making type.

GREAT BRITAIN TO BUILD PLANTS FOR AMMONIUM PRODUCTS, CARBIDE, AND CARBON

From Our London Correspondent

THE Government has recently introduced a land fertility scheme, under which basic slag and lime are now subsidized. In view of the subsidy a number of lime works in various parts of England are now re-opening for lime burning. Over three hundred producers and three thousand distributors of lime and basic slag have been approved under the scheme. It came into operation early in September, and within two months applications were made for exchecquer contributions in respect of 103,000 tons, on which the contributions are estimated to amount to £60,000. As pointed out at the annual meeting of a well-known fertilizer manufacturer early in November, however, it is questionable whether the farmer will reap the full benefit of this plan unless he makes a careful calculation of the relative values of the comparatively insoluble phosphates in basic slag and of soluble phosphate which is available in other forms.

According to the 1936 report of the Rothampsted Experimental Station, just published, the results of recent investigations indicate that there is little possibility of any effective substitute being found for the leading contact insect poisons, i.e., derris and pyrethrum. Work which has been carried out with a view to producing synthetic organic compounds having similar ideal properties in being fatal to insect life but non-injurious to animals and plants are reviewed in the report. The most toxic product at present available is apparently 3-5-dinitrocresol, but it has been found to have certain undesirable features which restrict its practical use. Lauryl thiocyanate, which is already under investigation in the United States, appears to be an insecticide of much promise.

New oil prospecting licenses in England and in Scotland continue to be granted by the Government, mainly to the Darcy Exploration Co. (representing interests of the Anglo-Iranian Oil Co.) and the Anglo-American Oil Co. The Falmouth Committee which was appointed by parliament for the purpose of considering and examining processes for the production of oil from coal was severely criticized in the House of Commons late in November. It was alleged that the promoters of one low-temperature carbonization process which showed great promise for producing oil from coal had been denied an opportunity of giving evidence before the committee, and that the committee's inquiries had been prejudiced by vested interests. It was also alleged that the Falmouth Committee had not taken into consideration the Fischer-Tropsch hydrogenation process.

The Calcium Carbide Factory Investigation Committee, after considering a number of schemes which have been submitted for the production of calcium carbide and allied products in the United Kingdom, has recommended the proposal submitted by the British Oxygen Co., for the erection of two factories, one at Port Talbot in South Wales and the other at Corpach in the West Highlands of Scotland. In order to proceed at Corpach the granting of parliamentary sanction for the necessary hydro-electric works must be awaited, and to effect this the Caledonian Water Power Bill is to be re-introduced to the House of Commons for a third time. The factory in South Wales, however, will be started almost immediately, at an estimated cost of about £1,000,000. The initial output of the South Wales factory will be 20,000 tons of carbide per year, provision being made for further units with a capacity of 20,000 tons as the demand increases. According to recent statistics, carbide imported during June, July and August, 1937, amounted to 14,500 tons, of which 8,300 tons came from Norway. Port Talbot is situated a short distance from abundant supplies of coal at low cost and extensive supplies of limestone are also available to promote the efficiency of production.

New works for the manufacture of ammonium products are to be built by Imperial Chemical Industries at Belleshill, Scotland, upon a site which has been purchased for that purpose by the Government. Fison, Packard & Prentice, Ltd., fertilizer manufacturers, is now planning important extensions in Lincolnshire. A Dutch company, N. V. Benninga's Friesche Margarinefabrieken, is proceeding with a plan for the production of margarine at Hull, where a new factory is to be erected at a cost of £200,000, mainly to refine raw material for the production of margarine.

A new factory for the manufacture of activated carbon is to be built near Cardiff by British Activon Industries Ltd. It is anticipated that production will commence early in 1938, using a special process which has been developed by Prof. C. L. Mantell, who is an authority on the subject. Large quantities of activated carbon are now imported into the United Kingdom for industrial purposes and for use in the filling of the gas masks which the Government is making. The efficiency of these gas masks has been so severely criticised in the House of Commons, that the Government has suggested holding any subsequent debate in secret. Imports of activated carbons and decolorizing carbons of vegetable origin, for the first nine months of 1937, were valued at nearly £39,000. The decolorizing carbons are subject to the payment of key industries duty.

American buyers have been in the British market recently for substantial quantities of naphthalene, and there has been considerable discussion on the question of prices. Mannitol (R. mannite) is now exempt from key industries duty until the end of 1938. The Import Duties Advisory Committee has not yet increased the duty on yellow prussiates, and producers of these products in the United Kingdom are complaining that the market for home-produced prussiates is very unsatisfactory because of competition from outside markets.

GERMAN CHEMICAL INDUSTRY DEVELOPED MANY NEW PRODUCTS LAST YEAR

From Our German Correspondent

THE PAST year has been one of rapid advance and changes for the German chemical industry. Though investments for plants for new products were costly and prospects for immediate profit not always present, the financial structure of the industry, especially of such enterprises as I. G. Farbenindustrie, is such that it was able to do a considerable part of the new financing from its own resources. Government price guarantees and subsidy as well as the general necessity for cooperation under the "Four Year Plan" provided the added incentives. Chemical exports were pushed and raw material shortages subsided somewhat, but the main emphasis was still placed upon the development of synthetics, many of which promise to stay even if normal trade relations are resumed.

The year saw Germany continue its leading position, quantitatively and qualitatively, in the dye field in spite of structural changes during and after the World War, which resulted in other countries building up their own industries. During the year, for instance, I. G. Farben has brought out between 100 to 150 improvements and new products in the dyestuff field alone, which has been partly responsible for being able to maintain its position. Nor could the changes in the textile, paint, and leather industries in Germany have taken place without the development and improvement of new dyes and colors.

National necessity, which has accelerated research in many fields, brought the commercial application of processes in 1937 which have been in the experimental stage for years. New processes and synthetic and "exchange" products introduced or greatly improved covered a wide range. They included the further introduction of "Buna" synthetic rubber; developing the magnesium alloy "Elektron," lighter than aluminum, and improving corrosion resistance of other metals; bringing out new building and road construction materials; commercially applying the "alkacid" and "catasulf" processes obtaining elementary sulphur as a by-product; improvement of synthetic waxes, paints, and tannery materials; further development of thermoplastics and materials based on Germany's abundant raw materials, coal and lime, including new synthetic fatty acids; new tropical medicines and pharmaceuticals, such as "Betaxin," the synthetic Vitamin B_1 developed in the Bayer laboratories; in photographics the "Agfacolor-Neu" colored moving picture and miniature camera film based on the subtractive principle; in the field of "Germany's white gold," new staple fibre products, and acid-and lye-resistant "PC" fibre with a coal and lime instead of cellulose base; hydrogenation of coal for synthetic motor fuels and Leuna "Treibgas" (a propane and butane mixture) for use not only as a heavy motor fuel but also for cooking, heating, and lighting; and many others.

The year also saw the construction of a number of new plants for synthetic motor fuels and synthetic fibres, and 1938 will see the completion of the new I. G. Wolfen Vistra plant with its own beech-wood cellulose preparation plant, which will make I. G. Farben the largest staple fibre producer in the world. Other milestones in the chemical field in 1937 were the establishment in Berlin of the "Zellwoll-Spinnband Vereinigung," a cooperative research organization which has helped already to simplify and cheapen the cost of staple fibre production; the establishment as an independent unit on March 17, 1937, of the "Buna-Werke G.m.b.H.," the leading German synthetic rubber plant; and the compulsory reduction of the price of nitrate fertilizers by 30 per cent on March 23, 1937, which is of importance to German agriculture as well as to the national and international chemical industry.

Wood, one of Germany's few abundant raw materials, is becoming the object of more intensive research as increasing quantities are being processed into cellulose products, synthetic fibres, and more recently into cattle fodder. Now the German chemical industry is being asked to substitute wood for rubber, copper, zinc, nickel, lead and their alloys wherever possible in building chemical apparatus and equipping chemical plants. Professor Kollmann of the Prussian Wood Research Institute at Eberswalde near Berlin, who has conducted extensive experiments, reports that apparatus and containers made from domestic wood can be used safely for handling a number of chemicals, including sulphuric acid up to 20 per cent concentration, and in the production of soda-, nitrate-, and phosphate of ammonia, dyes, magnesium chloride, sodium bichromate, and sodium sulphate. Aluminum, calcium, iron, potassium, and copper salts in solution, alcohol, formaldehyde, and hydrogen peroxide can also be satisfactorily handled in wood, which is attacked, however, by chlorine and phenols which dissolve the lignine. Impregnated or coated, as for example, with thin sheets of "Mipolam" (polyvinyl chloride plastic) instead of with lead, it is claimed that wooden containers can even be used for highly concentrated sulphuric acid. Setting an example, I. G. Farben is using wood successfully in its Ludwigshafen plants.

Of interest in the field of wood-sugar production is the announcement that a new model plant is to be erected in Regensburg. Although investments and production costs are admittedly high, advances toward commercial production are being made. The present year should see the completion of the new plant of the reorganized Deutsche Bergin A. G. fuer Holzhydrolyse, Heidelberg, part of which is now operating on an experimental basis. The German government, through the Reich Alcohol Monopoly, is promoting the Bergius wood-hydrolysis and Scholler-Tonesch wood-sugarization processes, not only as an additional source of alcohol, but also to lessen imports of cattle-cake by utilizing the albuminous cattle fodder from wood cellulose. It is estimated, for instance, that Germany's wood supply would suffice, after other needs have been filled, to produce 100,000 tons yearly of albumen for fodder purposes through these processes.

CALENDAR

INTERNATIONAL HEATING AND VENTILATING EXPOSITION, Grand Central Palace, New York City, January 24–28.

AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS, annual meeting, New York City, February 14–17.

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY, annual meeting, New York City, February 21–24.

AMERICAN CERAMIC SOCIETY, New Orleans, La., March 27–April 2.

AMERICAN CHEMICAL SOCIETY, semi-annual meeting, Dallas, Texas, April 18–21.

ELECTROCHEMICAL SOCIETY, Savannah, Ga., April 27–30.

INTERNATIONAL CONGRESS OF PURE AND APPLIED CHEMISTRY, Rome, Italy, May 14–21.

AMERICAN PETROLEUM INSTITUTE, mid-year meeting, Wichita, Kansas, May 23–25.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, semi-annual meeting, White Sulphur Springs, W. Va., May 9-16.

F. C. Frary

M. E. Clark

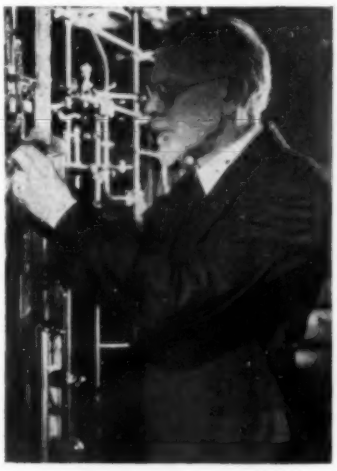
E. H. Leslie

M. A. Williamson

PERSONALITIES

✦ A. W. ALLEN recently left California to do some metallurgical work in Peru.

✦ JOHN H. CLARK, JR. has been appointed sales manager of T. Shriver & Co. to fill the vacancy left by the death of Robert E. Perry.



Charles A. Kraus

✦ CHARLES A. KRAUS, professor of chemistry at Brown University, has been named president-elect of the American Chemical Society. He will take office in 1939.

✦ MELVIN E. CLARK, who joined the staff of *Chem. & Met.* last July, has been promoted to the position of assistant editor. Mr. Clark is a chemical engineering graduate of the University of Colorado and is a former editor of the *Colorado Engineer*.

✦ FRANCIS C. FRARY, director of research for the Aluminum Research Laboratories of the Aluminum Co. of America, received the Pittsburgh Award for 1937 from the Pittsburgh section of the American Chemical Society. This honor was conferred upon Dr. Frary in recognition of his achievements in the metallurgy of aluminum.

✦ EMIL HEUSER, who has been director of research for the Canadian International Paper Co. since 1926, has been named research associate and instructor at the Institute of Paper Chemistry, Appleton, Wis.

✦ GORDON M. JACKSON, formerly of Alco Products Inc. and the Witt Ice and Gas Co., is now associated with Struthers-Wells as New York district manager of the heat exchanger division. He will be in charge of design, application and sales of heat exchanger equipment.

✦ P. E. LANDOLT, formerly eastern manager for the Western Precipitation Co., is now associated with C. S. Sale & Co., Inc., New York City, as chief engineer. Mr. Landolt is a former chairman of the New York chapter of A.I.Ch.E.

✦ E. H. LESLIE has joined the technical staff of the Blaw-Knox Co., Pittsburgh, Pa. In his new capacity, Dr. Leslie will be charged with the supervision of the design and fabrication of operating units for the chemical and oil refining industries. Since 1923, Dr. Leslie has carried on consulting engineering work at the Leslie Laboratories, Ann Arbor, Mich.

✦ A. CRESSY MORRISON has been elected president of the New York Academy of Sciences for the year 1938.

✦ MARVIN C. ROGERS, formerly chemical engineer in the research laboratory of the Standard Oil Co. of Indiana at Whiting, has been appointed assistant professor of chemical engineering at the University of Minnesota.

✦ GEOFF A. SAEGER has been appointed chief chemist for the Gulf Portland Cement Co. of Houston, Texas. Mr. Saeger leaves a position in the cement section of the Federal Bureau of Mines.

✦ ELMER H. SMITH, president of the Commercial Gas Co., Minneapolis, was elected president of the International Acetylene Association at its 38th Annual Convention held recently in Birmingham, Ala. Other newly-elected officers were: H. P. Dolisie, vice-president; H. F. Reinhard, secretary; Henry Booth, treasurer.

✦ M. A. WILLIAMSON, business manager of *Chem. & Met.* has been appointed vice-president of the McGraw-Hill Publishing Co. Mr. Williamson will continue as manager of *Chem. & Met.* and *Food Industries*. He has been associated with McGraw-Hill since 1920.

OBITUARY

✦ NELSON T. BRANCHE, chief engineer of development and design at the Bryant Heater Co. of Cleveland since 1935, died suddenly after a major operation on November 26.

✦ HARRY S. CALVERT, vice-president of The Pfaudler Co., died January 5.

✦ HERMAN SCHLUNDT, professor of chemistry, Univ. of Missouri, died December 30.

✦ G. D. CHAMBERLAIN, who prior to retirement in Florida was associated with the U. S. Steel Corp. and the Schoenberger Steel Co., died on December 28 at the age of 69 years.

Chemical ECONOMICS and MARKETS

PRODUCTION OF CHEMICALS ENTERS YEAR BELOW 1937 LEVEL

A SHARP decline in domestic industrial production is indicated by the November index of the Federal Reserve Board, which, for combined mining and manufacturing, was 90 as seasonally adjusted. As the index for October stood at 103, the extent of the drop in operations may be visualized. For manufacturing operations alone, the Board's adjusted indexes for 1936 ranged from a low of 92 in February to a high of 121 in December with an average of 105.25 for the year. For the first 11 months of 1937, the adjusted index for manufactures ranged from a low of 87 for November to a high of 118 reached in April, May and August with a monthly average for the 11-month period of 111.64 which will probably be reduced to about 109.4 when the index for December is included.

The index number for stocks of manufactured goods for January 1937 was 111 and for November it was 113. Stocks of chemicals and allied products were represented by the index number 143 in January which was increased to 156 for November.

As an indication of the outlook for the first quarter of this year, the Shippers' Advisory Board, reporting for 13 sections of the country, estimates a drop in carloadings for nine sections, increases in three sections—Pacific Coast, Northwest, and Atlantic States—and no change for the Southwest. The comparison is with the actual carloadings for the first quarter of 1937. For the entire country, the estimate indicates a decline of 8.3 per cent in the movement of goods for the first quarter of this year.

For some of the individual groups, the first quarter estimate anticipates an increase of 15.5 per cent in the movement of cottonseed and products except oil. For the following groups the percentages as enumerated represent decreases: iron and steel, 30.3; chemicals and explosives, 18.6; paper and prepared roofing, 9.3; salt, 0.6; and petroleum products, 0.4.

Consumption of silk in December as measured by deliveries to mills declined to 21,982 bales which was the lowest total for any month since December 1921. Apparent consumption of silk for the 12 months of 1937 was 425,299 bales compared with 454,640 bales in 1936 or a decrease of almost 6.9 per cent.

The accompanying tabulation for operations through the first eleven months of the year show that while the trend was downward in the latter part of the year, most of the products enumerated were holding a gain over the corresponding period of 1936.

Rubber reclaiming shows the highest relative gain for the period and while consumption has not kept pace with production, nevertheless an appreciable gain in consumption has been recorded. Production of glass containers also has held up well although the output of plate glass has been on a declining scale. Production of synthetic methanol established another all-time record in November with the total for the 11 months exceeding the 12-month production for 1936 by 2,362,563 gal. On the other hand, producers of crude methanol failed to turn out as much of that product in November as they had in November 1936. The sharp drop in steel manufacture naturally was reflected in the output of byproduct coke and crude coal-tar products but a fair gain over 1936 is still apparent.

Superphosphate production in plants of acidulators reporting to The National Fertilizer Association in November was 4 per cent less than in November of last year. This was the first time that production had been under the corresponding month of the preceding year since February 1936. The trend of production has been downward since late in the spring. November output in the Northern Area showed a good increase over last year but this was more than offset by a marked decline in the South.

Manufacturers sales declined 5.5 per cent during November, 1937, as compared with November, 1936, while the rate of collections on accounts receivable decreased, according to reports from manufacturers cooperating in the monthly joint study of the National Association of Credit Men and the Bureau of Foreign and Domestic Commerce.

Without adjustment for seasonal influences, November, 1937, sales fell off about 16 per cent from October, 1937.

Only three of the industry groups reported sales greater than in November 1936. The petroleum and machinery groups both recorded gains of about 11 per cent, while sales of food and kindred products increased fractionally over November, 1936. The paper and chemical industries showed moderate declines, but declines in the other industry groups ranged down to the 27 per cent decrease registered by nonferrous metals and their products.

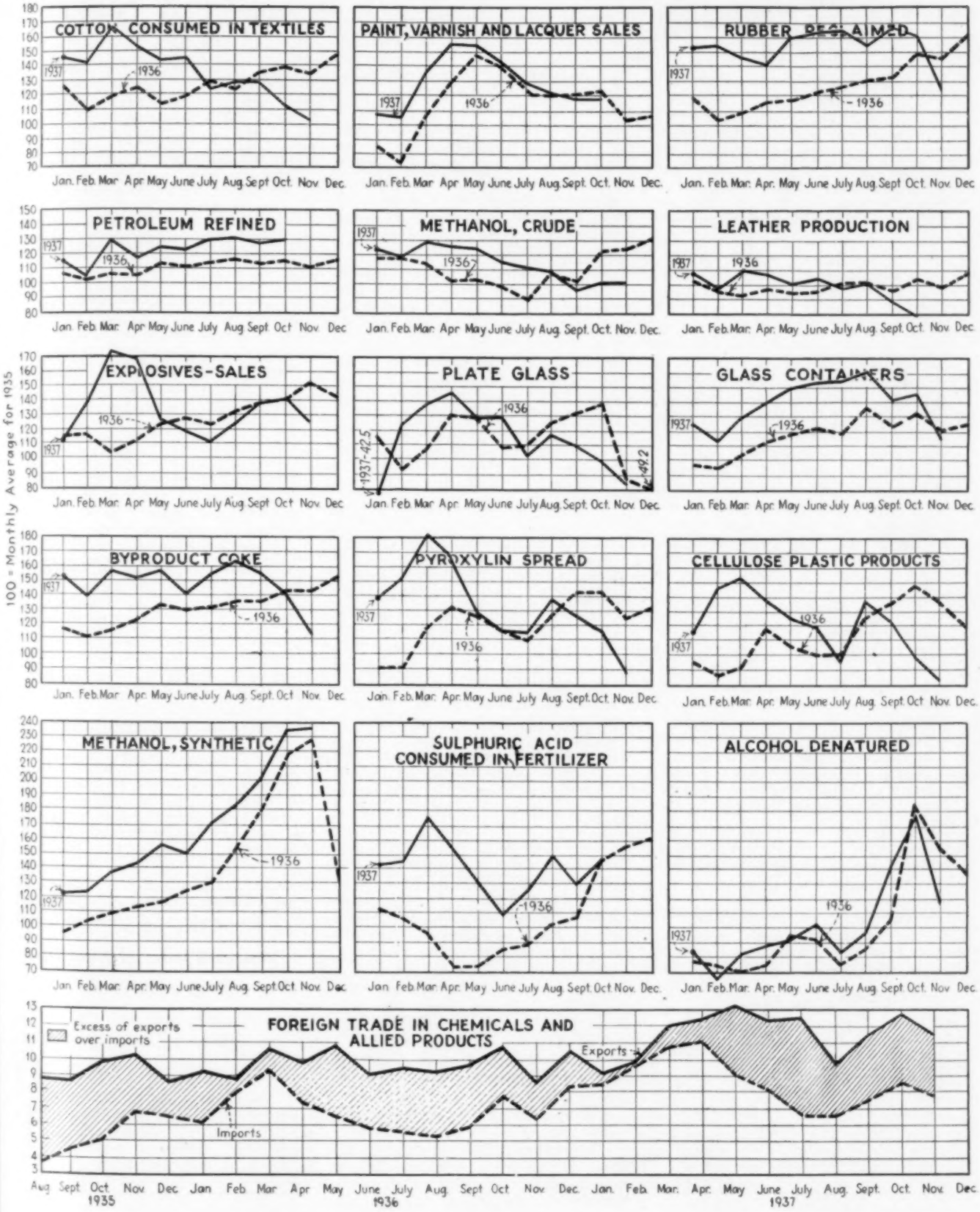
Chemicals and allied products as a group reported sales in November at a decline of 22.6 per cent under those for the preceding month and 3.3 per cent under those for November 1936. Sales of paints and varnishes for the same periods show declines of 22.6 per cent and 11.9 per cent.

Production and Consumption Data for Chemical-Consuming Industries

	Nov., 1937	Nov., 1936	Jan.-Nov., 1937	Jan.-Nov., 1936	Gain for 1937 Per cent
PRODUCTION					
Alcohol, ethyl, 1,000 pr. gal.	18,179	20,172	198,082	176,992	11.9
Alcohol, denatured, 1,000 wi. gal	9,610	12,617	91,876	88,232	4.1
Automobiles, 1,000	360	395	4,483	3,956	13.3
Ammonia, tons	50,234	62,806	733,700	626,592	17.1
Benzol, 1,000 gal	7,472	9,633	110,674	94,710	16.9
Byproduct coke, 1,000 tons	3,226	4,054	46,377	40,215	15.3
Cellulose acetate plastics, 1,000 lb	783	1,437	12,611	11,781	7.0
Nitrocellulose, plastics, 1,000 lb	1,067	1,594	17,120	15,537	10.2
Glass containers, 1,000 gr.	3,735	3,880	49,430	41,183	20.0
Plate glass, 1,000 sq. ft.	12,517	13,084	183,672	190,698	*3.8
Methanol, crude, 1,000 gal.	423	521	5,292	5,026	5.3
Methanol, synthetic, 1,000 gal	3,562	3,418	27,926	23,554	18.6
Rosin, wood, bbl	63,892	58,023	696,260	603,786	15.3
Turpentine, wood, bbl	10,149	8,866	108,586	95,236	14.0
Rubber reclaimed, tons	12,406	13,540	166,703	132,977	25.4
CONSUMPTION					
Cotton, 1,000 bales	485	626	6,990	6,408	9.1
Silk, bales	31,749	40,401	403,317	413,013	*2.4
Explosives, 1,000 lb.	31,125	37,453	360,520	343,306	5.0

* Percent. of decline.

TRENDS OF PRODUCTION AND CONSUMPTION



CHEMICALS OPEN YEAR ON PRICE LEVEL HIGHER THAN A YEAR AGO

DESPITE the fact that reduced call for chemicals in the latter months of last year brought about a downward turn in the price curve, earlier upward revisions were not entirely dissipated and the industry entered the new year with the average of values higher than it was in January 1937. This does not mean that prices for all chemicals have risen as lower markets now rule for some of the solvents, acetate of lime, acetic acid, citric, formic, and lactic acids, barium compounds, glycerine, casein, naval stores, etc.

Contracts for alkalis were written at about the same level as a year ago with the exception that jobbing lots held a higher premium for 1938 delivery. Quotations for sulphuric acid are higher than they were last January but they are not so strong as they were some months ago when consumption was running ahead of production. Gallic, tannic, and tartaric acids also hold a higher price position than was the case a year ago. Metal salts held an erratic course throughout last year under the influence of frequent fluctuations in the metal markets. Net changes find such products as antimony oxide, cobalt oxide, copper sulphate, lead acetate, lead arsenate, and zinc oxide on a higher plane than they were 12 months ago. Denatured alcohol, borax, cream of tartar, diethylene glycol, bichromates, and nitrate of soda also may be included in the list of chemicals which have risen in price during the last year.

A review of the price set-up for vegetable oils and fats shows a very different situation. The early part of last year found values for oils moving rapidly upward. The latter part of the year reversed this trend and comparison of the weighted index numbers for January 1937 and January 1938 throws into strong relief the extent to which values have declined. As a case in point, it is reported that a large amount of whale oil imported in bond in the early part of last year ran into a falling market and has now been reshipped to Europe where a better return might be obtained for the owner than by paying the duty and selling at prices current in our market.

Contract deliveries of many chemicals so far this month are reported to have reached a fair volume but most of the principal consuming industries are operating on curtailed schedules and it is evident that total consumption of raw materials, including chemicals, will fall short of the January 1937 figure. Views regarding the nearby outlook are so dependent upon improvement in the general manufacturing field that they mean but little.

Foreign Developments

Among developments in foreign markets it is reported that the South African Railways and Harbors Administration which is conducting research in connection with railway car refrigeration is reported to be experimenting with dry ice at present.

Sales of crude iodine by the Chilean Nitrate and Iodine Sales Corp. during the 1936–37 fiscal period increased more than 18 per cent over those of the preceding year, according to the company's last annual report.

Argentine exports of casein declined 15 per cent to a total of 12,400 metric tons during the first nine months of 1937 due mainly to smaller shipments to the United Kingdom, Germany, and the United States—consignments to the latter country declining from 2,300 metric tons to 1,400 metric tons. Shipments of casein to Japan during these periods, however, increased from 577 metric tons to 1,990 metric tons.

A battery of 72 coke ovens now being installed in Australia by the Australian Iron and Steel, Ltd. will have an output of 1,500,000 Imperial gallons of motor benzol per annum, all of which will be used by the Commonwealth Oil Refineries, Ltd. for blending purposes.

Announcement by the Chemical Division, Bureau of Foreign and Domestic Commerce of the development in Great Britain of a new gum known as "Manucol", has attracted so much interest that the division has obtained added information regarding the product. The added data is to the effect that the new gum, which is soluble Manucol V, pure and highly concentrated form of sodium alginate, and of high viscosity, and produces standard mucilages, which are transparent, water white and entirely free from odor. It can be produced to form either thick, true solutions, semi-jel mucilages, similar to those made with tragacanth or karaya, or in firm transparent jellies. The product is reported to be sensitive to electrolysis, alcohol or similar reagents, and thus can be made into jels into which glycerine, sugar and other similar products may be incorporated.

Soybean Oil for Paints

Initial results on the use of soybean oil for paints and varnishes as developed experimentally at the Bureau of Chemistry and Soils' laboratory in Urbana give encouraging prospects. The recently published formulas for the making of varnishes from this oil with phenolic and rosin ester resins, as well as the record of laboratory and exposure tests for these products, are most encouraging. The short weathering time out of doors has not been sufficient to determine the extent of the serviceability of the exposed paints but has sufficed to demonstrate the value of soybean oil varnishes.

At the recent meeting of the American Association for the Advancement of Science held at Indianapolis, the U. S. Regional Soybean Laboratory reported on the effect of hydroxyl groups and acetylation on the diene value of vegetable oils. It was disclosed that acetylation of soybean, linseed, and perilla oils resulted in a marked increase in the diene and peroxide values, and in all instances in a drop in the iodine value. Since these changes might be expected to accompany an improvement in the drying rate of soybean oil, this property is being intensively investigated under quantitative conditions at the Urbana Laboratory.

CHEM. & MET.

Weighted Index of CHEMICAL PRICES

Base = 100 for 1927

This month	**89.31**
Last month	89.28
January, 1937	87.26
January, 1936	87.21

There was a slight upturn to prices for chemicals during the month with advances in lead oxides, turpentine, and antimony oxide. Acetic acid was prominent among the chemicals for which lower prices were named.

CHEM. & MET.

Weighted Index of Prices for OILS AND FATS

Base = 100 for 1927

This month	**75.59**
Last month	77.02
January, 1937	109.35
January, 1936	92.36

Crude cottonseed oil held a fairly steady price level and limited offerings created a strong market for China wood oil. Most oils and fats, however, showed a declining price trend and the index number dropped appreciably.

Current PRICES

INDUSTRIAL CHEMICALS

	Current Price	Last Month	Last Year
Acetone, drums, lb.	$0.05½-$0.06½	$0.05½-$0.06½	$0.07 -$0.08
Acid, acetic, 28%, bbl., cwt.	2.23 - 2.48	2.38 - 2.63	2.45 - 2.70
Glacial 99%, drums	8.43 - 8.68	8.43 - 8.68	8.43 - 8.68
U. S. P. reagent	10.25 -10.50	10.25 -10.50	10.52 -10.77
Boric, bbl., ton	105.00-115.00	105.00-115.00	105.00-115.00
Citric, kegs, lb.	.24 - .27	.24 - .27	.25 - .28
Formic, bbl., ton	.10½- .11	.10½- .11	.11 - .11½
Gallic, tech., bbl., lb.	.75 - .78	.75 - .78	.60 - .65
Hydrofluoric 30% carb., lb.	.07 - .07½	.07 - .07½	.07 - .07½
Lactic, 44%, tech., light, bbl., lb.	.06½- .06½	.06½- .06½	6½ - .6½
Muriatic, 18°, tanks, cwt.	1.05 -.....	1.05 -.....	1.00 - 1.10
Nitric, 36°, carboys, lb.	.05 - .05½	.05 - .05½	.05 - .05½
Oleum, tanks, wks., ton	18.50 -20.00	18.50 -.....	18.50 -20.00
Oxalic, crystals, bbl., lb.	.10½- .12	.10½- .12	.10½- .12
Phosphoric, tech., c'bys., lb.	.09 - .10	.09 - .10	.09 - .10
Sulphuric, 60°, tanks, ton	13.00 -.....	13.00 -.....	11.00 -11.50
Sulphuric, 66°, tanks, ton	16.50 -.....	16.50 -.....	15.50 -.....
Tannic, tech., bbl., lb.	.40 - .45	.40 - .45	.20 - .30
Tartaric, powd., bbl., lb.	.24½- .25½	.24½- .25½	.22½- .23½
Tungstic, bbl., lb.	2.75 -.....	2.75 -.....	2.50 - 2.75
Alcohol, Amyl	.....	.....	.....
From Pentane, tanks, lb.	.123-.....	.123-.....	.143-.....
Alcohol, Butyl, tanks, lb.	.08½-.....	.08½-.....	.08½-.....
Alcohol, Ethyl, 190p'f., bbl., gal.	4.14 -.....	4.14 -.....	4.14 -.....
Denatured, 190 proof	.....	.....	.....
No. 1 special, dr., gal wks.	.34 -.....	.34 -.....	.32 -.....
Alum, ammonia, lump, bbl., lb.	.03 - .04	.03 - .04	.03 - .04
Potash, lump, bbl., lb.	.03½- .04	.03½- .04	.03 - .04
Aluminum sulphate, com bags cwt.	1.35 - 1.50	1.35 - 1.50	1.35 - 1.50
Iron free, bg., cwt	2.00 - 2.25	2.00 - 2.25	2.00 - 2.25
Aqua ammonia, 26°, drums, lb.	.02½- .03	.02½- .03	.02½- .03
tanks, lb.	.02½- .02¾	.02½- .02¾	.02½- .02¾
Ammonia, anhydrous, cyl., lb.	.15½-.....	.15½-.....	.15½- .16
tanks, lb.	.04½-.....	.04½-.....	.04½-.....
Ammonium carbonate, powd tech., casks, lb.	.08 - .12	.08 - .12	.08 - .12
Sulphate, wks., cwt.	1.425	1.40 -.....	1.25 -.....
Amylacetate tech., tanks, lb.	.11¼- .12	.11¼- .12	.11 - .11½
Antimony Oxide, bbl., lb.	.15 - .15½	.14½- .15	.12½- .13
Arsenic, white, powd., bbl., lb.	.03 - .03¼	.03 - .03¼	.03¼- .04
Red, powd., kegs, lb.	.15½- .16	.15½- .16	.15½- .16
Barium carbonate, bbl., ton	52.50 -57.50	52.50 -57.50	56.50 -58.00
Chloride, bbl., ton	79.00 -81.00	72.00 -74.00	72.00 -74.00
Nitrate, cask, lb.	.07 - .08	.07 - .08	.08½- .09
Blanc fixe, dry, bbl., lb.	.03½- .04	.03½- .04	.03½- .04
Bleaching powder, f. o b., wks., drums, cwt.	2.00 - 2.10	2.00 - 2.10	2.00 - 2.10
Borax, gran., bags, ton	46.00 -51.00	46.00 -51.00	44.00 -49.00
Bromine, cs., lb.	.30 - .32	.30 - .32	.36 - .38
Calcium acetate, bags	1.65 -.....	1.65 -.....	2.10 -.....
Arsenate, dr., lb.	.06½- .07	.06½- .07	.06 - .07
Carbide drums, lb.	.05 - .06	.05 - .06	.05 - .06
Chloride, fused, dr., del., ton	21.50 -24.50	21.50 -24.50	20.00 -33.00
flake, dr., del., ton	23.00 -25.00	23.00 -25.00	22.00 -35.00
Phosphate, bbl., lb.	.07½- .08	.07½- .08	.07½- .08
Carbon bisulphide, drums, lb.	.05 - .06	.05 - .06	.05½- .06
Tetrachloride drums, lb.	.05½- .08½	.05½- .06	.05½- .06
Chlorine, liquid, tanks, wks., lb.	2.15 -.....	2.15 -.....	2.15 -.....
Cylinders	.05½- .06	.05½- .06	.05½- .06
Cobalt oxide, cans, lb	1.67 - 1.70	1.67 - 1.70	1.41 - 1.51
Copperas, bgs., f.o.b., wks., ton	15.00 -16.00	15.00 -16.00	15.00 -16.00
Copper carbonate, bbl., lb.	.09 - .16½	.09 - .16½	.11½- 16
Sulphate, bbl., cwt	4 50 - 4.75	4.50 - 4.75	4.70 - 5.00
Cream of tartar, bbl., lb.	.19½- .20	.19½- .20	.16½- .17
Diethylene glycol, dr., lb.	.22 - .23	.22 - .23	.16½- .20½
Epsom salt, dom., tech., bbl., cwt.	1.80 - 2.00	1.80 - 2.00	1.80- 2.00
Ethyl acetate, drums, lb.	.07½-.....	.07½-.....	.07 -.....
Formaldehyde, 40%, bbl., lb.	.05½- .06½	.05½- .06½	.05½- .6½
Furfural, dr., lb.	.10 - .17½	.10 - .17½	.10 - .17½
Fusel oil, ref. drums, lb.	.16 - .18	.16 - .18	.16 - .18
Glaubers salt, bags, cwt	.95 - 1.00	.95 - 1.00	.85 - 1.00
Glycerine, c.p., drums, extra, lb.	.15½-.....	.15½-.....	.24½-.....
Lead:			
White, basic carbonate, dry casks, lb.	.06½-.....	.06½-.....	.07½-.....
White, basic sulphate, sck., lb.	.06½-.....	.06½-.....	.06½-.....
Red, dry, sck, lb.	.0735-	.07½-.....	.085-.....
Lead acetate, white crys., bbl., lb.	.11 - .12	.12 - .13	.11 - .11½
Lead arsenate, powd., bbl., lb.	.13 - .13½	.13 - .13½	.09 - .10
Lime, chem., bulk, ton	8.50 -.....	8.50 -.....	8.50 -.....
Litharge, pwd., csk., lb.	.0635-	.06½-.....	.07½-.....
Lithophone, bags, lb.	.04½- .04¾	.04½- .04¾	.04½- .05
Magnesium carb., tech., bags, lb.	.06 - .06½	.06 - .06½	.06 - .06½

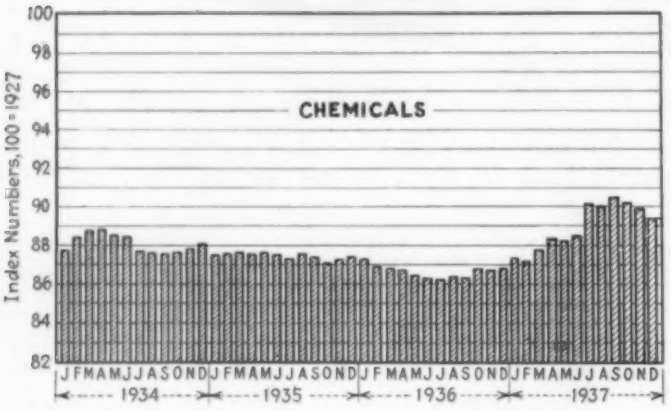
	Current Price	Last Month	Last Year
Methanol, 95%, tanks, gal.	.31 -.....	.31 -.....	.33 -.....
97%, tanks, gal.	.32 -.....	.32 -.....	.34 -.....
Synthetic, tanks, gal.	.33 -.....	.33 -.....	.35½-.....
Nickel salt, double, bbl., lb.	.13 - .13½	.13 - .13½	.13 - .13½
Orange mineral, csk., lb.	.10½-.....	.10½-.....	.11½-.....
Phosphorus, red, cases, lb.	.40 - .42	.40 - .42	.44 - .45
Yellow, cases, lb.	.24 - .30	.24 - .30	.28 - .32
Potassium bichromate, casks, lb.	.08½- .09	.08½- .09	.08½- .09
Carbonate, 80–85%, calc. csk., lb.	.06½-.....	.06½-.....	.07 - .07½
Chlorate, powd., lb.	.09½-.....	.09½- .09	.08 - .08½
Hydroxide (c'stic potash) dr., lb.	.07 - .07½	.07 - .07½	.07 - .07½
Muriate, 80% bgs., ton	23.00 -.....	23.00 -.....	23.00 -.....
Nitrate, bbl. lb.	.05½- .06	.05½- .06	.05½- .06
Permanganate, drums, lb.	.18½- .19	.18½- .19	.18½- .19
Prussiate, yellow, casks, lb.	.15 - .16	.15 - .16	.16 - .17
Sal ammoniac, white, casks, lb.	.05 - .05½	.05 - .05½	.04½- .05
Salsoda, bbl., cwt.	1.00 - 1.05	1.00 - 1.05	1.00 - 1.05
Salt cake, bulk, ton	13.00 -15.00	13.00 -15.00	13.00 -15.00
Soda ash, light, 58%, bags, contract, cwt.	1.23 -.....	1.23 -.....	1.23 -.....
Dense, bags, cwt.	1.25 -.....	1.25 -.....	1.25 -.....
Soda, caustic, 76%, solid, drums, contract, cwt.	2.60 - 3.00	2.60 - 3.00	2.60 - 3.00
Acetate, works, bbl., lb.	.04½- .05	.04½- .05	.04½- .05
Bicarbonate, bbl., cwt.	1.75 - 2.00	1.75 - 2.00	1.75 - 2.00
Bichromate, casks, lb.	.06½- .07	.06½- .07	.06½- .07
Bisulphate, bulk, ton	15.00 -16.00	15.00 -16.00	15.00 -16.00
Bisulphite, bbl., lb.	.03½- .04	.03½- .04	.03½- .04
Chlorate, kegs, lb.	.06½- .06¾	.06½- .06¾	.06½- .06¾
Chloride, tech., ton	12.00 -14.75	12.00 -14.75	12.00 -14.75
Cyanide, cases, dom., lb.	.16½- .17	.16½- .17	.15½- .16
Fluoride, bbl., lb.	.07½- .08	.07½- .08	.07½- .08
Hyposulphite, bbl., cwt.	2.40 - 2.50	2.40 - 2.50	2.40 - 2.50
Metasilicate, bbl., cwt.	2.15 - 3.15	2.15 - 3.15	2.15 - 3.15
Nitrate, bags, cwt.	1.45 -.....	1.45 -.....	1.375-.....
Nitrite, casks, lb.	.07 - .08	.07 - .08	.07½- .08
Phosphate, dibasic, bags, lb.	1.85 -.....	1.85 -.....	.022- .024
Prussiate, yel. drums, lb.	.10 - .11	.10- .11	.10 - .11
Silicate (40° dr.) wks., cwt.	.80 - .85	.80 - .85	.80 - .85
Sulphide, fused, 60–62%, dr., lb.	.02½- .03¼	.02½- .03	.02½- .03
Sulphite, cyrs., bbl., lb.	.02½- .02¾	.02½- .02¼	.02½- .02¼
Sulphur, crude at mine, bulk, ton	18.00 -.....	18.00 -.....	18.00- .....
Chloride, dr., lb.	.03 - .04	.03 - .04	.03½- .04
Dioxide, cyl., lb.	.07 - .08	.06½- .08	.07 - .07½
Flour, bag, cwt.	1.60 - 3.00	1.60 - 3.00	1.60 - 3.00
Tin Oxide, bbl., lb.	.48 -.....	.50 -.....	.55 -.....
Crystals, bbl., lb.	.34 -.....	.35 -.....	.38 -.....
Zinc. chloride, gran., bbl., lb.	.05 - .06	.05 - .06	.05 - .06
Carbonate, bbl., lb.	.14 - .15	.14 - .15	.09 - .11
Cyanide, dr., lb.	.36 - .38	.36 - .38	.36 - .38
Dust, bbl., lb.	.075-.....	.077-.....	.07 -.....
Zinc oxide, lead free, bag., lb.	.06½-.....	.06½-.....	.05½-.....
5% lead sulphate, bags, lb.	.06½-.....	.06½-.....	.05½-.....
Sulphate, bbl., cwt.	3.15 - 3.60	3.15 - 3.60	2.65 - 3.00

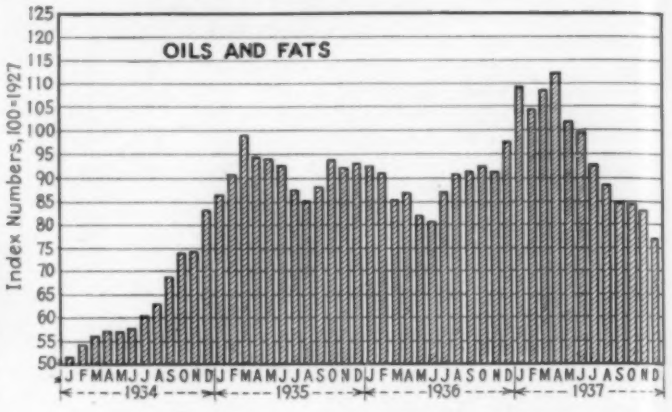
OILS AND FATS

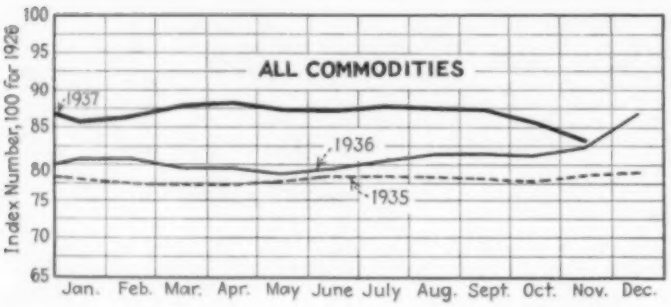
	Current Price	Last Month	Last Year
Castor oil, No. 3, bbl., lb.	$0.09½-$0.10	$0.10½-$0.11	$0.10 -$0.11
Chinawood oil, bbl., lb.	.15½-.....	.14½-.....	.15 -.....
Coconut oil, Ceylon, tanks, N. Y. lb.	.04½-.....	.04 -.....	.09½-.....
Corn oil crude, tanks (f.o.b. mill), lb.	.06¾	.06¾-.....	.10½-.....
Cottonseed oil, crude (f.o.b. mill), tanks, lb.	.06 -.....	.05¾-.....	.10½-.....
Linseed oil, raw car lots, bbl., lb.	.102-.....	.104-.....	.101-.....
Palm, casks, lb.	.04 -.....	.04 -.....	.06½-.....
Peanut oil, crude, tanks (mill), lb.	.06½-.....	.06½-.....	.10½-.....
Rapeseed oil, refined, bbl., gal.	.90 -.....	.90 -.....	.85 -.....
Soya bean, tank, lb.	.06 -.....	.06 -.....	.10 -.....
Sulphur (olive foots), bbl., lb.	.08 -.....	.09½-.....	.10½-.....
Cod, Newfoundland, bbl., gal.	.52 -.....	.52 -.....	.48 -.....
Menhaden, light pressed, bbl., lb.	.074-.....	.074-.....	.78 -.....
Crude, tanks (f.o.b. factory), gal.	.37½-.....	.34 -.....	.35 -.....
Grease, yellow, loose, lb.	.04½-.....	.05 -.....	.08½-.....
Oleo stearine, lb.	.09 -.....	.09 -.....	.12 -.....
Red oil, distilled, d.p. bbl., lb.	.09½-.....	.09½-.....	.10½-.....
Tallow extra, loose, lb.	.06½-.....	.06½-.....	.09½-.....

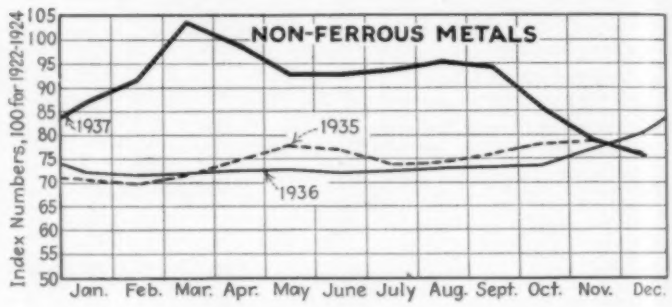
The accompanying prices refer to round lots in the New York market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to January 13

CHEM. & MET.'S WEIGHTED PRICE INDEXES









COAL-TAR PRODUCTS

	Current Price	Last Month	Last Year
Alpha-napthol, crude bbl., lb.	$0.52 –$0.55	$0.52 –$0.55	$0.60 –$0.62
Alpha-naphthylamine, bbl., lb.	.32 – .34	.32 – .34	.32 – .34
Aniline oil, drums, extra, lb.	.15 – .16	.15 – .16	.15 – .16
Aniline salts, bbl., lb.	.22 – .24	.22 – .24	.24 – .25
Benzaldehyde, U.S.P., dr., lb.	.85 – .95	.85 – .95	1.10 – 1.25
Benzidine base, bbl., lb.	.70 – .75	.70 – .75	.65 – .67
Benzoic acid, U.S.P., kgs., lb.	.52 – .54	.52 – .54	.48 – .52
Benzyl chloride, tech., dr., lb.	.25 – .27	.25 – .27	.30 – .35
Benzol, 90%, tanks, works, gal.	.16 – .18	.16 – .18	.16 – .18
Beta-napthol, tech., drums, lb.	.23 – .24	.23 – .24	.23 – .24
Cresol, U.S.P., dr., lb.	.12 – .13	.12 – .13	.10 – .11
Cresylic acid, 99%, dr., wks., gal.	.89 – .92	89 – .92	.73 – .75
Diethylaniline, dr., lb.	.50 – .55	.50 – .55	.55 – .58
Dinitrophenol, bbl., lb.	.23 – .25	.23 – .25	.29 – .30
Dinitrotoluen, bbl., lb.	.15 – .16	.15 – .16	.16 – .17
Dip oil, 25%, dr., gal.	.23 – .25	.23 – .25	.23 – .25
Diphenylamine, bbl., lb.	.32 – .36	.32 – .36	.38 – .40
H-acid, bbl., lb.	.50 – .55	.50 – .55	.65 – .70
Naphthalene, flake, bbl., lb.	.07½– .07¾	.07½– .07¾	.07½– .07¾
Nitrobensene, dr., lb.	.08 – .09	.08 – .09	.08½– .10
Para-nitraniline, bbl., lb.	.45 – .47	.45 – .47	.45 – .47
Phenol, U.S.P., drums, lb.	.14½–.....	.14½–.....	.13½– .14
Picric acid, bbl., lb.	.35 – .40	.35 – .40	.30 – .40
Pyridine, dr., gal.	1.55 – 1.60	1.55 – 1.60	1.10 – 1.15
Resorcinal, tech., kegs, lb.	.75 – .80	.75 – .80	.65 – .70
Salicylic acid, tech., bbl., lb.	.34 – .40	.34 – .40	.40 – .42
Solvent naptha, w.w., tanks, gal.	.30 –.....	.30 –.....	.26 –.....
Toludine, bbl., lb.	.88 – .90	.88 – .90	.88 – .90
Toluene, tanks, works, gal.	.35 –.....	.35 –.....	.30 –.....
Xylene, com, tanks, gal.	.35 –.....	.35 –.....	.30 –.....

MISCELLANEOUS

	Current Price	Last Month	Last Year
Barytes, grd., white, bbl., ton.	$22.00–$25.00	$22.00–$25.00	$22.00–$25.00
Casein, tech., bbl., lb.	.10½– .12	.12 – .13	.19½– .20½
China clay, dom., f.o.b. mine, ton.	8.00 –20.00	8.00 –20.00	8.00 –20.00
Dry colors			
Carbon gas, black (wks.), lb.	.0295– .20	.03 – .20	.04 – .20
Prussian blue, bbl., lb.	.36 – .37	.36 – .37	.37 – .38
Ultramarine blue, bbl., lb.	.10 – .26	.10 – .26	.10 – .26
Chrome green, bbl., lb.	.21 – .30	.21 – .30	.26 – .27
Carmine red, tins, lb.	4.00 – 4.40	4.00 – 4.40	4.00 – 4.40
Para toner, lb.	.75 – .80	.75 – .80	.75 – .80
Vermilion, English, bbl., lb.	1.60 – 1.65	1.60 – 1.65	1.69 – 1.72
Chrome yellow, C. P., bbl., lb.	.14½– .15½	.14½– .15½	.12 – .14
Feldspar, No. 1 (f.o.b. N.C.), ton.	6.50 – 7.50	6.50 – 7.50	6.50 – 7.50
Graphite, Ceylon, lump, bbl., lb.	.06 – .06½	.06 – .06½	.07 – .08½
Gum copal Congo, bags, lb.	.08 – .30	.08 – .30	.08 – .30
Manila, bags, lb.	.08½– .14	.08½– .14	.09 – .14
Damar, Batavia, cases, lb.	.16 – .24	.16 – .24	.15½– .16
Kauri cases, lb.	.18½– .60	.18½– .60	.19 – .25
Kieselguhr (f.o.b. N. Y.), ton.	50.00 –55.00	50.00 –55.00	50.00 –55.00
Magnesite, calc, ton	50.00 –.....	50.00 –.....	50.00 –.....
Pumice stone, lump, bbl., lb.	.05 – .07	.05 – .08	.05 – .07
Imported, casks, lb.	.03 – .40	.03 – .40	.03 – .35
Rosin, H., bbl.	7.20 –.....	6.40 –.....	11.85 –.....
Turpentine, gal.	.32½–.....	.31 –.....	.49 –.....
Shellac, orange, fine, bags, lb.	.21 –.....	.21 –.....	.25 –.....
Bleached, bonedry, bags, lb.	.17 –.....	.17 –.....	.19½–.....
T. N. Bags, lb.	.12 –.....	.12 –.....	.14 –.....
Soapstone (f.o.b. Vt.), bags, ton.	10.00 –12.00	10.00 –12.00	10.00 –12.00
Talc, 200 mesh (f.o.b. Vt.), ton.	8.00 – 8.50	8.00 – 8.50	8.00 – 8.50
300 mesh (f.o.b. Ga.), ton.	7.50 –10.00	7.50 –10.00	7.50 –11.00
225 mesh (f.o.b. N. Y.), ton.	13.75 –.....	13.75 –.....	13.75 –.....

INDUSTRIAL NOTES

THE LUMMUS CO., New York, has established an office at 411 West Fifth St., Los Angeles, with V. O. Bowles in charge.

ETHYL GASOLINE CORP., New York, has announced that, effective Jan. 1, Harry W. Kaley has been appointed general sales manager.

THE WATSON-STILLMAN CO., Roselle, N. J., has transferred its district sales office from Columbus to the Book Bldg., Detroit. J. C. Grindlay is western sales manager.

MONSANTO CHEMICAL CO., St. Louis, as of Dec. 20, liquidated and absorbed the Merrimac Chemical Co., Everett, Mass. The business of the Merrimac Chemical Co. will be continued as the Merrimac Division, Monsanto Chemical Co.

THE CAMBRIDGE WIRE CLOTH CO., Cambridge, Md., has appointed George B. Fletcher, The Investment Bldg., Pittsburgh, as sales engineer for the Pittsburgh territory.

LINCOLN ELECTRIC CO., Cleveland, has opened a welding sales-engineering office in the Title Bldg., Atlanta, Ga., under the management of Robert Daniels.

MICHIANA PRODUCTS CO., Michigan City, Ind., has added H. J. Georgen to its sales staff with headquarters at 80 East Jackson Blvd., Chicago.

New CONSTRUCTION

Where Plants Are Being Built in Process Industries

	Current Projects		Cumulative 1937	
	Proposed Work	Contracts	Proposed Work	Contracts
New England	$40,000	$40,000	$1,650,000	$2,742,000
Middle Atlantic	309,000	2,130,000	17,601,000	19,757,000
South	380,000	.....	31,390,000	38,709,000
Middle West	130,000	.....	14,223,000	24,287,000
West of Mississippi	785,000	655,000	19,617,000	13,463,000
Far West	40,000	639,000	9,865,000	12,288,000
Canada	1,020,000	120,000	47,600,000	9,152,000
Total	$2,704,000	$3,584,000	$141,946,000	$120,398,000

PROPOSED WORK

Benzol Distillation Plant—Steel Co. of Canada, H. G. Hilton, Works Mgr., Wilcox St., Hamilton, Ont., Can., contemplates the construction of a 3 story benzol distillation plant to replace one destroyed by fire. The owners are interested in prices of complete equipment. Estimated cost $250,000.

Carbon Black Plant—B. H. Ashe, Guymon, Okla., has applied for a permit to construct a carbon black plant near Guymon. Estimated cost $100,000.

Charcoal Plant—General Traders Corp., Ltd., 37 Crown St., Quebec, Que., Can., is having plans prepared for the construction of a plant for the manufacture of charcoal, peat and chemicals. Estimated cost $50,000.

Chemical Plant—Vick Chemical Co., 122 East 42nd St., New York, N. Y., contemplates the construction of a chemical factory on Hope St., Stamford, Conn. Estimated cost $40,000.

Cotton Oil Plant—Opelousas Cotton Oil Co., J. P. Barnett, Pres., Opelousas, La., will soon start work on the construction of a cotton oil plant. Estimated cost $100,000.

Distillery—Meagher Bros. Co., Ltd., Britania St., Montreal, Que., Can., is having plans prepared by E. Barott, Archt., 606 Cathcart St., Montreal, for an addition to its distillery. Estimated cost $50,000.

Factory—Air Reduction Sales Co., 60 East 42nd St., New York, N. Y., will soon award the contract for a factory on Second St., Berkeley, Calif.

Factory—Alligator Rubber Products Co., Inc., 239 Ridgewood Ave., Newark, N. J., contemplates the construction of a factory later in the year.

Factory—North West Distillery Co., Ltd., Medicine Hat, Alta., Can., is having plans prepared for the construction of a plant for the manufacture of industrial alcohol. New equipment will be purchased. Estimated cost $130,000.

Laboratory—Corning Glass Works, Corning, N. Y., will soon receive bids for the construction of a 4 story, 80x125 ft. laboratory. $150,000.

Laboratory—Refrigeration & Air Conditioning Institute, 2150 West Lawrence Ave., Chicago, Ill., will soon award the contract for a 3 story, 50x100x250 ft. laboratory. Pereira & Pereira, 221 North La Salle St., Archts. Estimated cost $100,000.

Laboratory—Standard Oil Co. of New Jersey, Bayway Refinery, Linden, N. J., plans to construct a 1 story, 30x80 ft. laboratory and other additions to its refinery. Estimated cost $39,000.

Paper Mill—Premier Paper Co., 809 West Main St., Louisville, Ky., plans to construct a factory and storage plant to replace the one destroyed by fire. Estimated cost including equipment $40,000.

Pottery Plant—Frankome Pottery Co., Norman, Okla., plans to construct a new manufacturing plant in Norman or Sapulpa. Estimated cost $25,000.

Refinery—Asiatic Petroleum Co., Bayonne, N. J., has purchased 7 acres on Kill van Kull in the Constable Hook section of Bayonne and plans to expand its present plant which adjoints on the north.

Refinery—British American Oil Refineries, Ltd., Sherbrooke St., Montreal, E., Que., Can., plans to construct an addition to its refinery. Estimated cost $500,000.

Refinery—Canfield Refining Co., Coraopolis, Pa., contemplates repairs and alterations to its refinery. Estimated cost $40,000.

Refinery—Duvall Gasoline Co. has had final plans prepared for the construction of an 8,000,000 cu. ft. natural gasoline plant in Duvall County near Alice, Tex. Estimated cost $100,000.

Refinery—Jennings Refinery Co., E. V. Kennedy, Frank E. Hood and W. C. Lewis, Houston, Tex., owners, plan to construct an oil refinery on Bayou Neypique near Jennings, La.

Refinery—Corporation c/o D. R. Leckie, Kelowna, B. C., Can., contemplates the construction of an oil refinery at High River, Alta., Can. Estimated cost will exceed $40,000.

Refinery—Lookout Oil & Refinery Co., 4608 Kirkland Ave., Chattanooga, Tenn., plans to construct a factory and power house. Estimated cost $100,000.

Refinery—Mammoth Producing & Refining Co., Corpus Christi, Tex., plans to construct an oil refinery to have a capacity of 3,500 bbls. daily. Estimated cost $250,000.

Refinery—Oriental Refining Co., S. H. Keoughan, Pres., 2622 Forest St., Denver, Colo., recently incorporated, has acquired a small refinery of the Denver Refining Co., East 52nd St. and Colorado Bldg., Denver, and plans to improve to have a capacity of 1,500 bbl. daily. Estimated cost $150,000.

Refinery—Yale Oil Corp., Kalispell, Mont., contemplates the construction of an oil refinery. Estimated cost $40,000.

Tunnel Kiln—Universal Potteries Co., Cambridge, O., plans to construct a modern tunnel kiln at its Oxford plant here. Estimated cost between $30,000 and $35,000.

Wood Preserving Plant—Gulf Wood Preserving Co., Fernwood, Miss., contemplates the construction of a wood preserving plant. Estimated cost $100,000.

Vinegar Factory—J. D. Bates, c/o Arkansas Vinegar Co., Shreveport, La., and J. Burgie, c/o Burgie Vinegar Co., Memphis, Tenn., contemplate the construction of a factory near Blue Star St., on the San Antonio Belt & Terminal Ry. property, San Antonio, Tex. Estimated cost $80,000.

Storage Building—Gulf Refining Corp., Port Arthur, Tex., will soon award the contract for a 1 story, 83x175 ft. barreling storage or warehouse building.

CONTRACTS AWARDED

Chemical Factory—Stanolind Oil Co., Tulsa, Okla., has awarded the contract for a chemical manufacturing plant to Waller-Wells Construction Co., 2423 East 13th Pl., Tulsa, Okla. Estimated cost $100,000.

Cork Factory—Armstrong Cork Co., 1206 Maple Ave., Los Angeles, Calif., has awarded the contract for a factory at South Gate, Calif., to Lindgren & Swinerton, 605 West Olympic Blvd., Los Angeles. Estimated cost $300,000.

Factory—Celluloid Corp., 290 Ferry St., Newark, N. J., has awarded the contract for alterations and repairs to its factory on Ashby and Dearcy Sts., Newark, to Enstice Bros., 895 Frelinghuysen Ave., Newark. Estimated cost $40,000.

Factory—E. I. Du Pont De Nemours & Co., Du Pont Bldg., Wilmington, Del., Krebs Pigment & Color Corp., subsidiary, 1007 Market St., Wilmington, and Newport, Del., is building a sulphuric acid recovery plant, at 5311 Curtis Ave., Curtis Bay, Md. Work is being done by company forces. Estimated cost $2,000,000.

Factory—S. B. Penick Co., 132 Nassau St., New York, N. Y., drug manufacturers, has acquired the plant of the former United Cork Co., at Grant and New York Aves., and Delaware, Lackawanna & Western R. R. at Lyndhurst, N. J., and will alter same for its own use. Work will be done by day labor and separate contracts. Estimated cost including equipment $40,000.

Fertilizer Factory—Grose Fertilizers & Chemicals, Ltd., 9 Evelyn Cr., Toronto, Ont., Can., has awarded the contract for a 2 story, 37x100 ft. factory and 2 story, 30x40 ft. office building on Dundas St., Toronto, to Schultz Construction, Ltd., 45 Albian St., Brantford, Ont. Estimated cost $45,000.

Refinery—Amsco Refining Co. (unit of American Mineral Spirits Co.) Corpus Christi, Tex., is building an addition to its refinery in the Luby Fields in Neuces County near Corpus Christi to have a capacity of 6,000 bbl. Work is being done by owner's forces. Estimated cost $275,000.

Refinery—Premier Oil & Refining Co., Longview, Tex., is building a 3,000 bbl. oil refinery in Webster Parish, near Minden, La. Work is being done by force account. Estimated cost $75,000.

Refinery—Travis Petroleum Co., 416 North Eastern St., Oklahoma City, Okla., has awarded the contract for a pressure oil refinery to H. V. Kirkpatrick, 2221 North East 10th St., Oklahoma City. Estimated cost $25,000.

Refinery—Universal Oil Refineries, Amarillo, Tex., have started work on a 2,500 bbl. per day capacity oil refinery at Pueblo, Colo. Estimated cost $50,000.

Refinery—Valley Refining Co., Roswell, N. M., has awarded the contract for an oil cracking unit at its refinery to Born Engineering Co., Tulsa, Okla. Estimated cost $40,000.

Storage Tanks—Pontiac Refining Co., Corpus Christi, Tex., has awarded the contract for two 80,000 bbl. capacity storage tanks to Mid-Continent Engineering Co., Corpus Christi and Dallas. Estimated cost $90,000.

Varnish Factory — Brandon-Henderson, Ltd., 6634 St. Urbain St., Montreal, Que., Can., has awarded the contract for a varnish factory on Atlantic Ave., Outremont, Que., Can., to Anglin Norcross Corp., Ltd., 892 Sherbrooke St., W., Montreal. Estimated cost $75,000.

Warehouse—Colgate-Palmolive-Peet Co., Carlton and Sixth Sts., Berkeley, Calif., has awarded the contract for a warehouse to Austin Co., Bay Bldg., Oakland, at $35,859.

Warehouse—E. J. Cox Paper Co., 111 Harrison St., Fall River, Mass., has awarded the contract for a warehouse addition to James T. Sampson & Sons, 280 New Boston Rd., Fall River. Estimated cost $40,000.

Warehouse—Owens-Illinois Pacific Coast Co., 1855 Folsom St., San Francisco, Calif., has awarded the contract for a warehouse on Fruitvale Ave. and The Estuary to P. J. Walker Co., Sharon Bldg., San Francisco. Estimated cost $300,000.

Warehouse—United States Gypsum Co., Engineering Dept., 300 West Adams St., Chicago, Ill., has awarded the contract for a warehouse and storage building at 58th St. and Schuylkill Ave., Philadelphia, Pa., to Turner Construction Co., Architects Bldg., Philadelphia. Estimated cost $50,000.

JAPANESE PRODUCTION OF SODA ASH AND CAUSTIC SODA ADVANCES STEADILY

IN a report to the Department of Commerce from Paul P. Steintorf, assistant commercial attache at Tokyo, it is stated that no individual financial group dominates or controls the Japanese chemical industry. At present there are at least eight important groups actively engaged in production of the more important basic chemicals. The direct control of these groups over production of the leading basic chemicals accounts for not more than 75 per cent of the total, leaving a substantial portion under the control of numerous small independent companies. It is impossible to ascertain the extent to which the nominally independent producers are dominated by the great family financial interests. Quite obviously, interests such as Mitsui and Mitsubishi are able to exert a measure of control over the independents by their enormous facilities for distribution and by their close affiliations, and in some cases complete control of the banks which finance the independent producers.

The soda ash industry has made rapid progress in recent years. Production has risen from 57,235 metric tons in 1930 to 215,180 tons in 1936, according to official figures of the Department of Commerce and Industry. These figures are for production for sale only and exclude very substantial quantities consumed where produced for the manufacture of caustic soda.

At the present time there are eight producers of soda ash and three others are planning to enter the field. The productive capacity at present is reported as 713,000 metric tons per year, which is far above actual production. As previously noted, complete production figures are unobtainable, but trade estimates place 1936 production at approximately 400,000 metric tons, including amounts used for production of caustic soda. This is at the rate of 56 per cent of theoretical capacity, this comparatively poor showing being attributed to unsatisfactory supplies of raw materials and to the completion of a substantial portion of the total productive capacity during the latter part of the year. Trade estimates distribute consumption of soda ash in Japan during 1935 as follows:—51 per cent for caustic soda, 28 per cent for glass, 11 per cent for miscellaneous chemicals, 7 per cent for dyestuffs and 3 per cent for soap.

Caustic Soda Industry

In line with other basic chemicals, the production of caustic soda has been mounting very rapidly in recent years. Production amounted to only 48,536 metric tons in 1931 and rose to 233,288 tons in 1935. Official figures for 1936 are unavailable but trade estimates place the year's total at 280,000 metric tons. Of the total production, 60 per cent is produced by causticizing soda ash and 40 per cent by electrolysis of salt.

The above tabulations clearly show that Japanese consumption of soda ash and caustic soda has been increasing steadily and home production has been gaining even more rapidly. In 1927, Japan produced about 2,500 metric tons of ash and 26,500 metric tons of caustic. United States exports to Japan in 1927 were 2,541 short tons of ash and 14,406 short tons of caustic. In 1929 our exports to Japan had risen to 17,519 short tons of ash and 22,657 short tons of caustic whereas in 1933 they had dropped to 4,308 short tons of ash and 1,776 short tons of caustic.

The distribution of caustic soda consumption in 1935 is estimated as follows:

	Per Cent
For rayon manufacture	51
For dyestuffs	17
For soap making	15
For paper, textiles and drugs	10
For other purposes	7

Supply and Distribution of Caustic Soda

metric tons

Year	Supply: Production	Supply: Imports	Supply: Total	Distribution: Exports	Distribution: Consumption	Total
1933	110,953	12,481	123,434	5,116	118,318	123,434
1934	177,771	9,931	187,702	12,297	175,405	187,702
1935	233,288	19,942	253,230	17,501	235,729	253,230
1936[1]	280,000	11,591	291,591	23,917	267,674	291,591

[1] Preliminary estimates.

Production Capacity in Soda Ash Industry

Controlling Interests	Name of Company	Capital of Co. (1,000 Yen)	Annual capacity: End of 1936 (metric tons)	Annual capacity: When extensions are completed (metric tons)
Iwai Shoten	Tokuyama Soda	15,000	240,000	300,000
Mitsubishi	Asahi Glass	14,457	240,000	240,000
Independent	Toyo Soda	6,500	120,000	180,000
Nakano (Nippon Soda)	Kyushu Soda	2,500	50,000	210,000
Aikawa (Nippon Sangyo)	Dai Nippon Fert	33,730	18,000	18,000
Watanabe	Ube Soda	.....	.....	10,000
Noguchi	Chosen Nitrogen Fert.	62,500	6,000	16,000
Independent	Kanan Kogyosho	.....	9,000	9,000
S. M. Railway	Manshu Soda	.....	30,000	60,000
	Total		713,000	1,043,000

Supply and Distribution of Soda Ash

metric tons

Year	Supply: Production	Supply: Imports	Supply: Total	Distribution: Exports	Distribution: Consumption	Total
1933	129,961	21,712	151,673	.....	151,673	151,673
1934	165,292	16,491	177,783	15,407	162,376	177,783
1935	198,307	17,213	215,520	30,530	184,990	215,520
1936	215,180	17,404	232,584	21,406	211,178	232,584
1937 (6 months)	131,693	21,968	153,661	11,107	142,554	153,661

Caustic Soda Production by Electrolysis

Controlling Interest	Company	Factory Location	Annual Production Capacity — metric tons
Nakano	Nippon Soda K.K.	Nihongi	15,000
	Nippon Soda K.K.	Takaoka	4,000
	Hodogaya Soda K.K.	Hodogaya	3,000
Mitsui	Mitsui Mine K.K.	Omuda	8,000
	Hokkai Soda K.K.	Fushiki	5,000
	Rayon Soda K.K.	Fushiki	5,000
Noguchi	Chosen Nitrogen K.K.	Konan	12,000
	Asahi Benberg K.K.	Nobeoka	10,000
Mori	Showa Jinken K.K.	Nishiki	10,000
	Nippon Denki Kogyo K.K.	Yokohama	8,000
Aikawa	Dai Nippon Fertilizer	Oji	9,000
Independents	Osaka Soda K.K.	Amagasaki & Kokura	10,000
	Showa Soda K.K.	Nagoya	7,000
	Asahi Denka Kogyo K.K.	Ogu	7,000
	Shikoku Soda K.K.	Sakade	7,000
	Nankai Soda K.K.	Ozuka & Kochi	6,000
	Sara Kogyo K.K.	Osaka	4,000
	Tsurumi Soda K.K.	Tsurumi	4,000
	Saito Ryuso	Osaka	3,000
	Toyo Artificial Fert.	Amagasaki	3,000
	Osaka Bleaching Powder	Osaka	2,000
	Ozaki Senryo K.K.	Kotoura	2,000
	Tokai Soda K.K.	Nagoya	2,000
	Velvet Soap K.K.	Amagasaki	2,000
			148,000